Federal-Provincial Advisory Committee on Environmental and Occupational Health

National Guidelines for Environmental Noise Control

Procedures and concepts for the drafting of environmental noise regulations/by-laws in Canada

Health and Welfare Canada
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National Guidelines for Environmental Noise Control

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Prepared by:

Working Group on Environmental Noise
of Federal/Provincial Advisory Committee
on Environmental and Occupational Health

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This is the first edition of
National Guidelines for Environmental Noise Control

Your comments and suggestions for improvement are welcome.

Please send comments to:

Mrs. D.A. Morison
Non-Ionizing Radiation Section
Bureau of Radiation and Medical Devices
National Health and Welfare
Room 65B, Health Protection Building
Tunney's Pasture
Ottawa, Ontario K1A 0L2

An initial review of this document is planned in three years. It is anticipated that there will be a five-year review of the document with updates at that time if required.

March 1989

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Executive Summary

The "National Guidelines for Environmental Noise Control" (National Guidelines) are being prepared for municipalities, consultants, provincial planners, industries, designers and legislators at all levels of government. These Guidelines present methods for the assessment and measurement, and legislative control of environmental noise. The purpose is to encourage noise control in Canada and establish a common national basis for this type of work while, at the same time, providing options to allow flexibility of choice for meeting specific regulation needs.

The National Guidelines are divided into two main parts and 10 sections. The beginning sets out the intent and organization, the general government jurisdictional arrangements, and how the document might be used (Sections 1 and 2).

Part I contains the concepts and procedures essential to control environmental noise; the technical reference material to carry out this noise control is in Part II. Specifically, Part I is divided into Sections 3, 4 and 5. Section 3 describes the procedures involved in developing a noise control program, and makes reference to other sections as required. Sections 4 and 5 describe Model Noise Control Legislation and Land Use Planning, respectively, which are two major components of environmental noise control.

Part II contains Sections 6 to 10, inclusive. Section 6 deals with the noise instrumentation, measurement and prediction methods used in the document; the appropriate Canadian Standards Association standards will be included in the references when they are published. Section 7 describes Noise Reduction Techniques with reference to environmental noise, and is intended to give an overview to those unfamiliar with the field.

Section 8 on Technical Support Documents contains all the relevant available Canadian resource documents on sound level criteria in Canadian jurisdictions. The text contains brief summaries of the various documents, which are included in full on microfiche, found in the folder at the end of the document. Section 9 contains terms and interpretations common throughout the document, both technical and those required for legal purposes such as the development of model noise control by-laws or regulations. Section 10 lists references given throughout the text.

Following an initial review in three years, it is anticipated that there will be a five-year review of the document with updates at that time if required.

Abstract

These National Guidelines have been prepared for legislators at all levels of government, provincial planners, municipalities, consultants, industries and designers. The intent is to provide a common basis across Canada for the assessment, measurement and legislative control of environmental noise while, at the same time, providing options to allow flexibility of choice to fit specific needs. The National Guidelines may be adopted or modified, in entirety and in part, into provincial or municipal legislation, or into codes of practice.

The National Guidelines are divided into two major parts. Part I, Concepts and Procedures, details the various options available in developing a noise control program and includes a section on Land Use Planning and Model Noise Control Legislation presenting sound level objectives and more general by-laws. The second part of the document contains technical reference material, including a section on instrument specification, measurement and prediction, and another covering noise reduction techniques. Terms and interpretations, references and technical support documents are included also. The texts of the technical support documents are briefly summarized in the document and are reproduced on microfiche at the end of the National Guidelines.

The National Guidelines were prepared by the Working Group on Environmental Noise of the Federal/Provincial Advisory Committee on Environmental and Occupational Health which intends to provide periodic revisions.

1. Introduction

1.1 General

The World Health Organization (WHO) defines health as a state of complete physical, mental and social well-being. It states "Governments have a responsibility for the health of their people which can be fulfilled only by the provision of adequate health and social measures" (WH 70).

The experience of the United States Environmental Protection Agency and of many Canadian cities and municipalities is that unwanted sound, or noise, is one of North America's most widespread nuisances (US 81). Noise is more than just a nuisance since it constitutes a real and present danger to people's health. Day and night, at home, at work and at play, noise can produce serious physical and psychological stress. No one is immune to this stress. People appear to adjust to noise by ignoring it but the ear, in fact, never closes. The body at times still responds with extreme tension, such as to a strange sound in the night.

The most common outward symptom of stress building up inside humans, when faced with noise, is annoyance. Perhaps partly because of this irritation, public annoyance and material discomfort form the basis of many environmental noise abatement criteria.

For some people, there may be a small risk that exposure to the stress of high noise levels increases susceptibility to disease and infection. For this segment of the population, noise could be a complicating factor in heart problems and other diseases. Noise that causes annoyance and irritability in healthy persons may have serious consequences for those already mentally or physically ill (US 81). The effect of noise on many necessary day-to-day functions, such as speech communication and listening, affect young and old alike. Some may also have trouble falling asleep and obtaining the amount of rest vital to their well-being.

Noise interfering with speech communication is among the most significant adverse effects of environmental noise on people. Free, easy speech communication is essential to fully develop individual and social relations, and is impeded seriously if individuals cannot be heard or understood because of noise.

The 20-year period, 1965-85, saw a rise in noise levels (OE 84a). This increase may be attributed to three phenomena: a 50 percent growth in the urban population of Western countries, greater mobility (the number of motor vehicles has tripled and air traffic has increased tenfold), and the spread of mechanization to virtually every activity (OE 84a).

Transportation is by far the major source of noise, with road traffic the chief offender. Aircraft noise is next in terms of population exposure. Transportation noise is particularly high in North America where the proportion of population exposed is four times higher than in Europe or Japan (US 81). Railway noise, and noise from stationary sources such as industrial establishments, generally affect a more limited proportion of the population.

Noise exposure can vary considerably from region to region, from town to town, and even from one district to another within the same town. Factors such as population density can play a very significant role. In general, noise exposure levels are higher in urban areas, which are more densely populated and therefore have a higher traffic density.

People are subjected to noise from a multiplicity of sources, either simultaneously (e.g., road traffic and aircraft noise) or successively (e.g., in the home, while commuting, at work). Noise exposure at work, outdoors, during travel, at home and during recreation should all be considered to avoid underestimating the real level of exposure to noise and its subsequent effects.

Three distinct types of environmental noise sources can be identified easily in the community.

1. Stationary sources. Due to their specific location, they can sometimes affect the significance of noise on people. A good example is air conditioning equipment. Industrial equipment can also be of concern to residential and other sensitive land uses.
2. Mobile sources from transportation noise. The most prevalent sources are motor vehicles, including cars, trucks, buses and motorcycles which create noise that can be heard almost everywhere. Other transportation sources, which affect fewer people but affect them more severely, are airport operations, railroad operations, ships, motor boats and motorized off-road vehicles.
3. Noise generated directly by man and animal activities, including children playing, outdoor parties and dogs barking.

It is fairly clear, from the variety of sources of community noise alone, that regulations need to be flexible.

Many stationary sources produce steady sound levels while operating; others produce somewhat more complex time-varying sound levels. Transportation noise and noise from people-related activities generally are more variable with time than noise from stationary sources.

1.2 Present Government Jurisdiction

Environmental noise is associated with numerous activities in the community (e.g., industry, commerce, transportation and residential activities), all of which are vital for the well-being of communities. Although control of noise

may be implemented at any level of government, it will be more effective and efficient if all levels are involved in a coordinated and mutually supportive approach.

1.2.1 Federal

The primary responsibility of the federal government in environmental noise control is to establish maximum exterior emission standards for a variety of products, equipment and vehicles. The federal government sets emission standards and ensures that manufacturers of new products meet them. However, these regulations do not extend to "after sale" situations where conditions may further deteriorate and exceed original sound levels required at the point of manufacture. The federal jurisdiction also includes noise control over interprovincial transportation systems including aircraft and airports, trains and navigable waterways. Finally, the federal government oversees national codes and guidelines to encourage uniformity.

1.2.2 Provincial

Provincial governments are responsible through various provincial statutes for controlling the operational noise levels of many products, equipment and vehicles. Provincial governments authorize municipalities to create municipal plans and by-laws to abate individual sources of noise.

1.2.3 Municipal

Most environmental noise control legislation, however, has been passed at the municipal level.

Municipalities exercise environmental noise control through enabling provincial acts, regulations and policies. Examples include:

(i) municipal noise control by-laws
(ii) municipal land use plans and zoning
(iii) traffic management
(iv) road noise barrier retrofit programs.

Municipal departments handling these tasks include by-law enforcement departments, local boards of health, planning, transportation, local police or building departments.

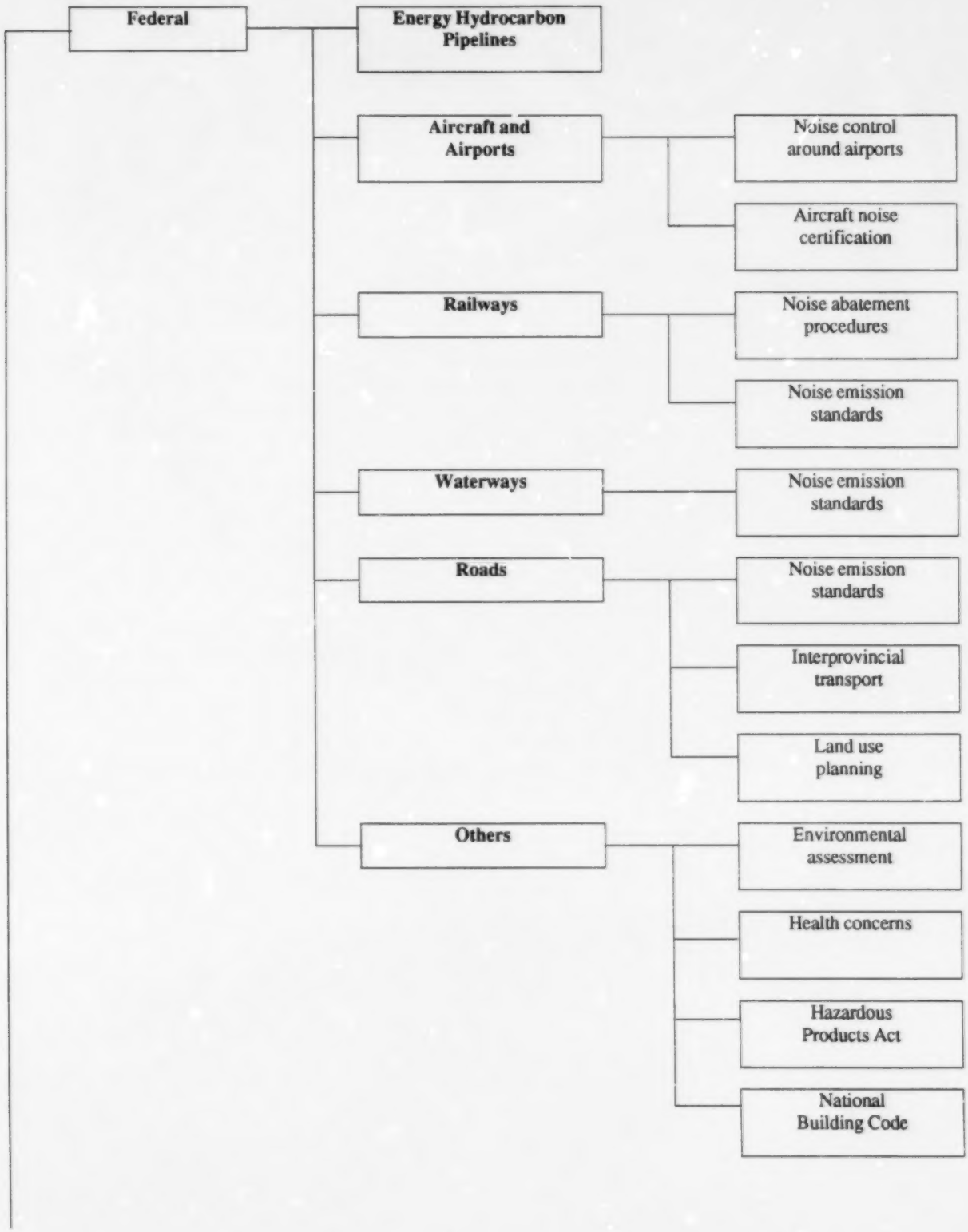
1.2.4 Summary

Each of the three levels of government in Canada has distinct responsibilities regarding environmental noise control and abatement:

1. Federal Level
   - to establish specification of noise emission at the equipment manufacturing level
     (NOTE: This specification may require laboratory type sound level measurement facilities which are very difficult to duplicate in the field.)
   - to establish guidelines for noise control affecting interprovincial transportation systems such as air carriers, shipping and rail transport
   - to establish national guidelines to encourage uniformity in measurement standards and interpretation.
2. Provincial Level
   - to establish guidelines for noise control in land use planning
   - to enable legislation and implementation assistance for municipal noise control by-laws (monitoring, interpretation and training)
   - to review and approve municipal noise control by-laws for uniformity.
3. Municipal Level
   - to pass noise control by-laws
   - to establish by-law enforcement
   - to implement delegated provincial policies.

Figure 1.1 is a schematic summarizing the kinds of responsibilities and activities in environmental noise in Canada. Table 1.1, which follows, lists related Canadian legislation and guidelines for environmental noise.

Figure 1.1 Responsibilities and Activities in Environmental Noise



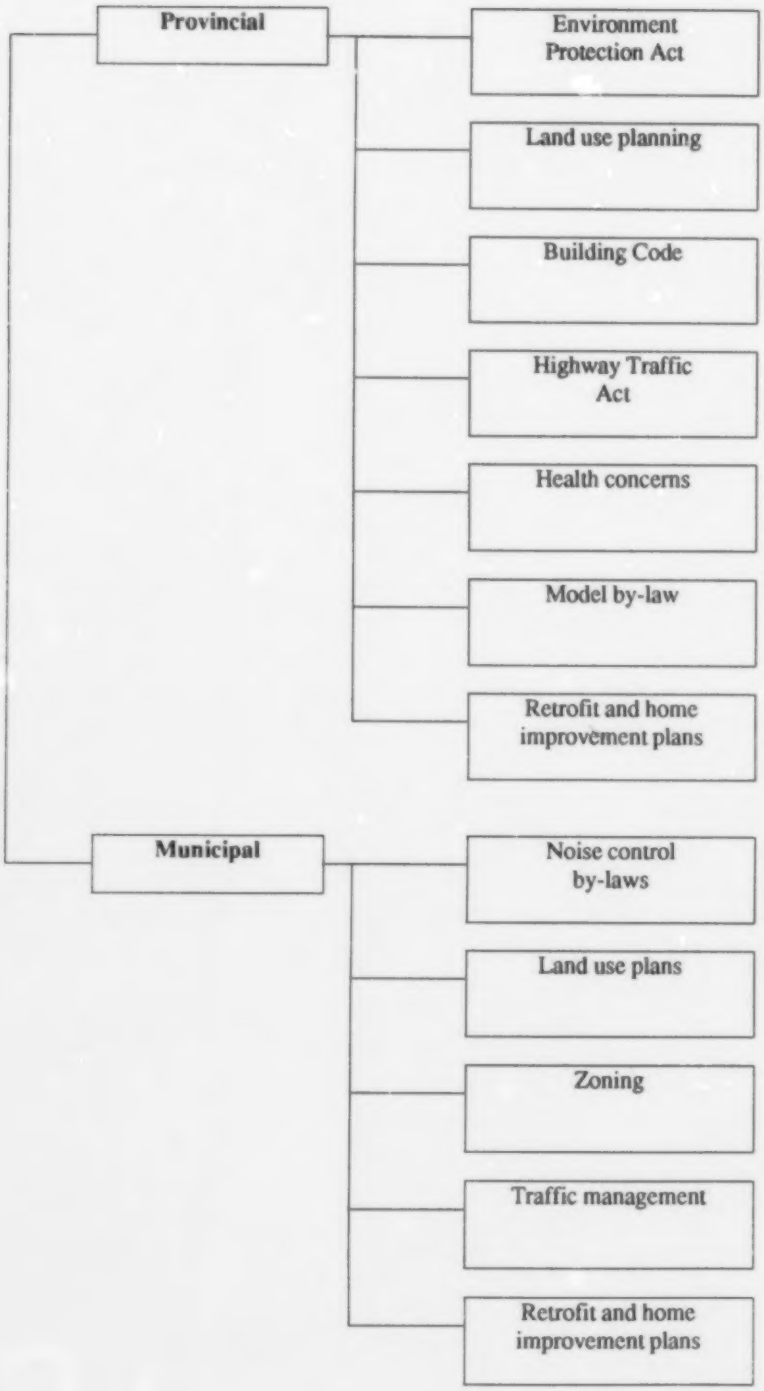

Provincial
Environment Protection Act
Land use planning
Building Code
Highway Traffic Act
Health concerns
Model by-law
Retrofit and home improvement plans
Municipal
Noise control by-laws
Land use plans
Zoning
Traffic management
Retrofit and home improvement plans

Table 1.1 Related Canadian Legislation and Guidelines for Environmental Noise

Jurisdiction	Act	Regulations	Enforcing Agency
Province of British Columbia	Motor Vehicles Act (RSBC 1979, c. 288, s. 211.1 (d)) and Motor Vehicle Regulations, ss. 7.02, 7.03, 7A.01)	Excessive noise	Provincial police force
Municipalities of British Columbia	Municipal by-laws	Noise control by-laws	Some municipalities
Province of Alberta	Highway Traffic Act 1980, C H-7 (as amended)	None. General provisions for motor vehicle noise Section 46 - mufflers; Section 125 - shunting; Section 135 - disturbance of residential area	Provincial police forces (Peace Officers)
Province of Alberta	Municipal Government Act, 1980	Section 160 nuisance abatement by-law provision Section 161 permits municipalities to pass noise control by-laws	Municipalities
Province of Alberta	Planning Act, 1980, s. 147	Delineates Airport Vicinity Protection Zone for development restrictions	Municipalities
Province of Alberta	Energy Resources Conservation Act 1971	Interim Directive No. ID80-2	Alberta Energy Conservation Board
Province of Alberta	Department of Environment Act 1980	No regulations Identifies the prevention of noise and the control of noise levels resulting from commercial or industrial operations as a matter pertaining to the environment	Alberta Environment
Province of Alberta	Public Health Act (RSA 1970, c. 294)	Noise exposure standard	-
Province of Alberta	Mines Regulations Act (SBC 1968)		-
Province of Manitoba	Clean Environment Act	Clean Environment Commission issues orders to companies emitting pollution (noise)	Manitoba Department of Environment
Municipalities in Manitoba	Municipal by-laws	Some municipalities control noise from people's activities	Some municipalities

Table 1.1 (Cont.)

Jurisdiction	Act	Regulations	Enforcing Agency
Province of Saskatchewan	Saskatchewan Environmental Management and Protective Act	No	Inactive since 1980 (Saskatchewan Environment)
	Saskatchewan Vehicles Act 1983	General section on excessive vehicle noise	Saskatchewan police force
Municipalities in Saskatchewan	Municipal by-laws	Some municipalities have by-laws to control loud parties, barking dogs, lawn mowers, etc.	Some municipalities
Province of Ontario	Environmental Protection Act (RSO 1981, c. 138, as amended)	None - noise included as a contaminant (noise complaints and approvals of new sources) Also permits municipalities to pass noise control by-laws	Ministry of the Environment and Municipalities
Province of Ontario	Environmental Assessment Act (SO 1975, c. 69)	None - noise included as a contaminant (planning and approval of new major sources)	Ministry of the Environment
Province of Ontario	Planning Act	Provincial policy statement on noise; freeways, airports and railways, and general provisions for other sources	Ministry of Municipal Affairs Ministry of the Environment Regional/local municipalities
Province of Ontario	Building Code Act	Specific to building design	Municipalities
Province of Ontario	Municipal Act	None - permits municipalities to pass noise control by-laws	Municipalities
Province of Ontario	Condominium Act	None - approval of new condominium projects	Ministry of Municipal Affairs Ministry of the Environment Regional/local municipalities
Province of Ontario	Pits and Quarries Control Act	None - general and specific requirements under the guidelines regarding the noise/ vibration from existing and new pits and quarries (guidelines)	Ministry of Natural Resources Ministry of the Environment Ministry of Municipal Affairs Regional/local municipalities

Table 1.1 (Cont.)

Jurisdiction	Act	Regulations	Enforcing Agency
Province of Ontario	Highway Traffic Act (RSO 1970, c. 202, s. 49(3))	None - general provisions regarding motor vehicle noise	Ministry of Transportation and Communications Police
Province of Ontario	Agriculture Code of Practice (not an act)	General and specific provisions regarding noise in planning	Ministry of Agriculture and Food Ministry of the Environment Ministry of Municipal Affairs Regional/local municipalities
Municipalities in Ontario	Municipal noise control by-laws	Some municipalities have qualitative and some have quantitative noise control by-laws	Some municipalities
Municipalities in Ontario	Regional/municipal policies	General and specific policies to control noise in planning (new sources or receivers)	Some municipalities
Province of Quebec	Environment Quality Act	Regulations respecting hot mix asphalt plants and regulations regarding pits and quarries set noise limits for new installations at 45 (daytime) and 40 (nighttime) dB(A) For all other sources, noise is considered as a contaminant for which excessive emissions are forbidden by article 20 of the Act.	Ministry of the Environment
	Cities and Towns Act Municipal Code of Quebec	Permit municipalities to pass noise control by-laws	Ministry of Municipal Affairs
	Act respecting land use planning and development	Permits municipalities to adopt town planning by-laws (estate, construction), and zoning by-laws	Ministry of Municipal Affairs

Table 1.1 (Cont.)

Jurisdiction	Act	Regulations	Enforcing Agency
Municipalities in Quebec	Town planning by-laws	Noise prevention	All municipalities
	Municipal noise control by-laws	Most of the existing by-laws concern specific sources such as motor vehicles, snowmobiles, etc.	Some municipalities
	City of Montreal Regulation 4996	Comprehensive noise control regulation	City of Montreal
Province of Nova Scotia	Environmental Protection Act, 1973 as amended by 1975, c. 66	None - draft Environmental Noise Policy, 1978, domestic activities exempt	Department of the Environment
	Development Act	Approvals	
	Liquor Licence Board	No specific regulations but noise considered in Section 6 Application for licence (c) (vi) (vii) and Section 18 Entertainment (4)	Response to noise complaints
Municipalities in Nova Scotia	Municipal acts, town acts and city charters	No by-laws	Some municipalities
Province of New Brunswick	Clean Environment Act	Noise included as a contaminant in 1973 Environmental impact Assessments, approvals, noise complaints	Department of Municipal Affairs and the Environment New Brunswick
	Motor Vehicle Act	Equipment for motor vehicles	Department of Transportation Attorney General
Municipalities in New Brunswick	Municipal by-laws	Noise control by-laws	Some municipalities
Federal government	Motor Vehicle Safety Act (1975)	Motor Vehicle Safety Regulation 1106 entitled "Noise" applicable to trucks, buses, multipurpose passenger vehicles, motorcycles, motor driven cycles, mopeds, minibikes and passenger cars. Latest SOR 79-115 effective September 1, 1979.	Transport Canada
		Snowmobiles - Consolidated Regulations of Canada, 1978, c. 1038, s. 1202	

Table 1.1 (Cont.)

Jurisdiction	Act	Regulations	Enforcing Agency
Federal government	Aeronautics Act (c. A-3, RS, c. 2, s. 1). Amendment No. 11, October 1, 1985, Part I, s. 3.9, para. (f)	Air Regulations (CRC, c. 2) Amendment No. 30, December 15, 1981, Part IV, Division II, para. 521(c) (Air Navigation Orders (ANO), Series II, No. 21 and 27, January 1, 1986, SOR/86-73 and SOR/86-74).	Transport Canada
Federal government	National House Act (RSC 1970, CN-10)	CMHC Site Planning Handbook, SE-3	Canada Mortgage and Housing Corporation
Federal government	Hazardous Products Act (RSC 1970, c. N-3)	Hazardous Product Regulations (SOR/70-482)	Consumer and Corporate Affairs
Federal government	Radiation Emitting Devices Act 1970. Revised 1984	-	National Health and Welfare

2. Use of Document

2.1 Recommended Approach

This document presents methods for the assessment, measurement and legislative control of environmental noise to provide a common basis for this work across Canada while, at the same time, providing options to allow flexibility of choice for specific needs. This document may be adopted or modified, in whole or in part, for inclusion into provincial or municipal legislation, or into codes of practice or guidelines.

Although noise control can be implemented at any level of government, the intent is to encourage municipal control based on provincial and federal policy direction. This position has been taken based on findings that environmental noise problems are local and, without this municipal involvement, are difficult to solve.

Municipalities have to carry the burden in environmental noise abatement, although the planning processes usually are conducted through a coordinated approach between the various levels of government.

This document presents a logical sequence through which development of an environmental noise control program should proceed.

2.2 How to Start a Noise Control Program

2.2.1 The province or municipality should establish the *need* for a noise control program (Section 1.1).

(i) determine areas of authority and responsibility (Sections 1.2, 3.1.1)

(ii) develop "Provincially Appropriate" model by-laws (Section 4)

(iii) set "Provincial Criteria" Sections 3.2.2, 3.2.3, Table 3.3)

(iv) adopt "Provincial Procedures" (Sections 3.2.4, 3.2.5, 5, 6)

(v) adopt "Provincial Guidelines" (Section 8)

(vi) develop guidelines/policies/regulations to provide coverage in provincial jurisdictions not subject to a municipal environmental noise control program (Section 3.2.1)

(vii) transfer authority to municipalities to provide for the implementation of an environmental noise control program (Section 3.1.1).

2.2.2 The municipality should:

(i) determine areas of authority and responsibility (Section 1.2, 3.1.1)

(ii) review "Provincially" developed/adopted documents related to an environmental noise control program (Sections 3.2, 4, 5, 6, 8)

(iii) provide for abatement of existing sources by by-law adoption (Section 4)

a) qualitative (Section 4.1)
- determine enforcement mechanism

b) quantitative (Section 4.2)
- adopt "Provincial Criteria" (Sections 3.2.2, 3.2.3, Table 3.3)
- adopt "Provincial Procedures" (Sections 3.2.4, 3.2.5, 5, 6)
- adopt "Provincial Guidelines" (Section 8)
- determine enforcement mechanism

(iv) adopt/develop planning procedures for New Receivers of Noise in conjunction with "Provincial Authority" (Section 5.1.1, Figure 5.2)

(v) adopt/develop planning procedures for New Sources of Noise in conjunction with "Provincial Authority" (Section 5.1.2.)

3. Developing a Noise Control Program

This section provides a summary of the options and alternatives available to the various levels of government to control environmental noise. The jurisdictional responsibilities of each level of government outlined in Section 1 must be considered when developing a noise control program.

The process to develop a noise control program can be divided into the preparation stage and the design stage. The preparation stage involves a review of the legislative authority available to the agency, and the consideration of the land use planning process to be followed. The design stage includes determining the type of legislative approach, noise criteria, general procedures and control measures, and the type of training program to be developed to implement the noise control program.

3.1 Preparation

Before a noise control program can be developed, the available enabling legislation has to be reviewed by the control agency. The enabling legislation may provide for by-laws dealing with abatement of existing noise sources or noise control through land use planning with respect to new noise sources/receivers. Abatement control and land use planning often are handled by different agencies, and are discussed separately. The different steps to develop a noise control program are summarized in Figure 3.1.

3.1.1 Examine Legislative Authority

The noise control program is based on the authority made available through existing legislation. This legislation may make direct reference to specific noise standards and procedures to be followed or may provide only for the mechanism to develop appropriate guidelines. Amendments to the provincial legislation may be necessary. Even though the noise control agency will have to develop a program applicable to its own requirements, it is also important to try to gain some uniformity with adjacent jurisdictions. The situation where noise from one jurisdiction crosses the boundary into another with more stringent restrictions should be prevented if possible.

Several ways in which provincial legislation can provide the basis of a noise control program are:

(i) Provincial legislation may provide a broad process to control all types of contaminants, including noise and vibration, both in the workplace and the natural environment, and provide for control, planning and approval processes at the provincial level.

(ii) Enabling provincial legislation may empower local (regional) municipalities to enact by-laws controlling noise directly through noise by-laws.

(iii) Enabling provincial legislation may empower lower-tier government to exercise planning powers, both long-range (e.g., official plans in Ontario) and short-range (e.g., zoning by-laws in local municipalities).

For consistency, it may be appropriate for the noise control program to be "approved" by the provincial agency. However, even if the provincial agency does not "approve" a noise control program, some contact with other levels of government is useful and advisable.

3.1.2 Role of Land Use Planning

Environmental noise problems can be prevented only through appropriate land use planning.

Examination and clear understanding of existing planning processes at all levels of government are prerequisites to implement a noise control program. This review may identify the need for appropriate changes in policies and procedures of land use planning to achieve this aim.

Land use planning is affected by all levels of government — federal, provincial, municipal and, in some provinces, regional municipalities. This document covers details of land use planning in sections as it relates to noise considerations in local and provincial contexts. The reader is encouraged to refer to existing federal, provincial and municipal practices.

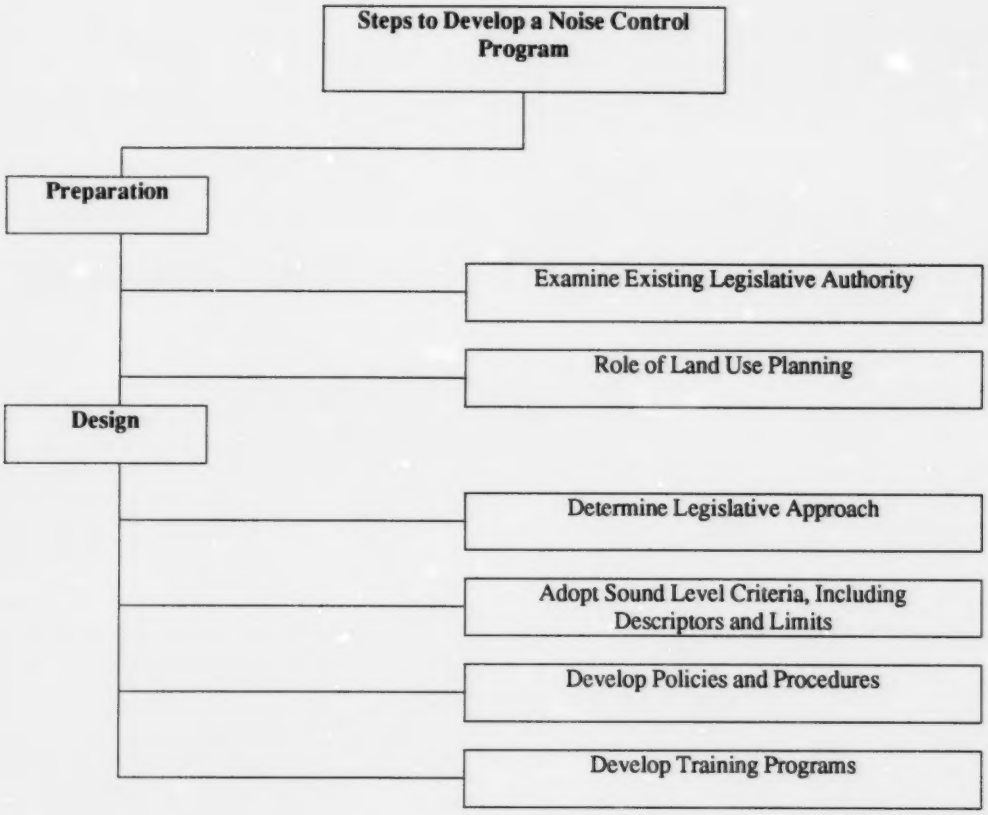
3.2 Design

3.2.1 Legislative Approach

The main focal areas of environmental noise control legislation are new sources, new receivers and abatement of existing noise. The first two are treated primarily through the approval/planning process (planning approaches are discussed more fully in Section 5).

The options available to abate environmental noise include the adoption of qualitative or quantitative legislation, or a combination of the two. These options refer primarily to the manner in which noise levels are assessed. In qualitative legislation, levels are assessed subjectively by the judgment of a "reasonable man" or by being "clearly audible". In quantitative

Figure 3.1


Steps to Develop a Noise Control Program
Preparation
Examine Existing Legislative Authority
Role of Land Use Planning
Design
Determine Legislative Approach
Adopt Sound Level Criteria, Including Descriptors and Limits
Develop Policies and Procedures
Develop Training Programs

legislation, levels are assessed objectively with measurement or mathematical modelling of sound levels by technically competent and trained enforcement staff.

Table 3.1 outlines some examples where qualitative and quantitative approaches to noise assessment are used most properly.

Many provincial and municipal jurisdictions in Canada have adopted regulations and/or by-laws to regulate noise in response to public complaints. Most are fairly simple depending on the qualitative description of noise based on reasonable man standards. The complaints also can be more complicated and require quantitative standards aimed at abating existing noise problems by using scientific methods of measurement and analysis.

One particular aspect to be considered is the manner in which a noise level is qualitatively judged to be excessive by the investigator. Where noise is treated as a nuisance that may cause inconvenience to an individual or interfere with enjoyment or use of property, the reasonable man concept may be applied by the courts.

As explained in a presentation by an Ontario Ministry of Environment solicitor, "The courts have said that when a man whose sensibilities are average, rather than fastidious for his circumstances, is bothered by noise impinging on his property, he is entitled to complain and the courts will assist in his efforts to have the bothersome noise checked. They have stated also that one cannot acquire a right to inflict noise on another's property unless that other property owner is actually there, suffering the noise and taking no action to prevent it. These standards established by the courts are all well and good if one considers it sufficient that a man be able to sue his neighbour who is making excessive noise. At some stage, it was thought desirable that a third party, namely the municipal authorities, should be able to intervene and assist in restraining the activities of noise makers by making and enforcing municipal by-laws to regulate and prohibit noise" (Fi 76).

The solicitor goes further to indicate that, "A by-law drafted in the simplest terms to prohibit noise likely to disturb the inhabitants is philosophically correct and technically unassailable. It sets exactly the right borderline level of sound and leaves it to the Court to apply this level in particular

Table 3.1 Manner of Assessing Noise

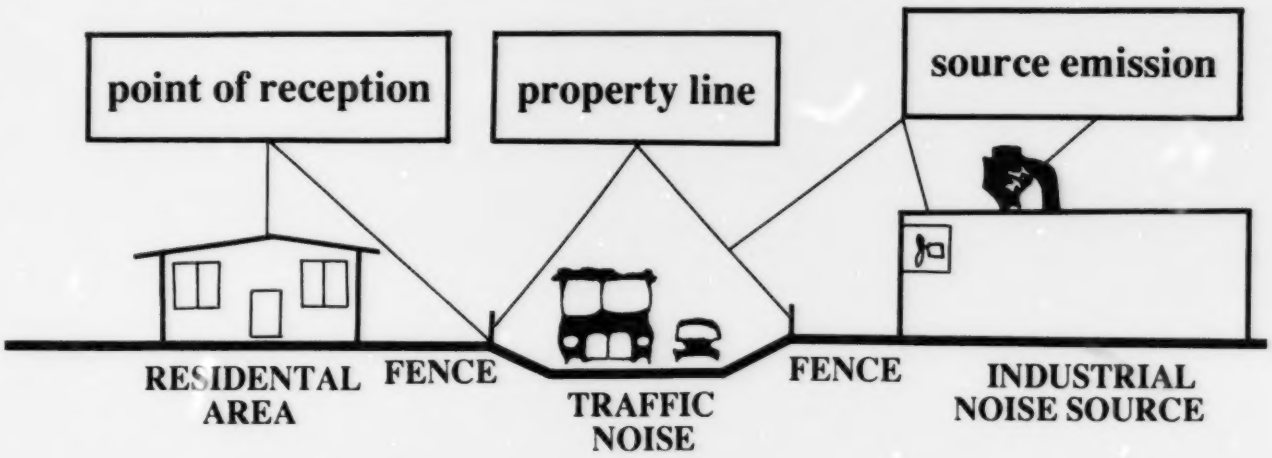
	Qualitative	Quantitative	
Noise problem/concerns where the respective approach is most effective	(no noise measurement)	Noise measurement	Mathematical modelling
Nuisance noise - noisy neighbour, vehicle shunting, noisy air conditioner, stereo, dog barking, etc.	- treated most effectively on the spot by the investigator - may or may not require noise measurement - simplest enforcement is based on judgment of by-law enforcement/ peace officer	(limited measurement)	
Abatement of existing problem - impact assessment (existing facility) - existing road/traffic noise, industrial noise, commercial activity, noise, railway noise		- will generally require some noise measurement to quantify problem - requires a noise standard for comparison of measured levels - involves noise monitoring equipment and manpower training requirements	
New sources - receivers - planning of new receivers and sources of noise - design considerations/ planning (new facility) - new subdivisions/roads or freeways, new industry	- specific provisions (e.g., minimum buffering distances)	(limited measurement)	- mathematical modelling may be the best or only way to predict what noise levels are likely from a new facility or noise source - noise measurement can serve to calibrate or verify the mathematical model - requires noise standards for comparison - generally requires electronic data processing (computer) capability/ availability

circumstances; however, the necessity of such subjective application and interpretation by the Courts is the downfall of such by-laws. At the least, it requires the testimony of an inhabitant of a municipality who was actually disturbed by the sound in question. At the most, it means that the prosecution of each such charge will become a full scale legal battle with enormous quantities of conflicting testimony based on subjective impressions, with respect to every point in question. If the municipality finds that it must go to great lengths to obtain a conviction under its noise control by-law, it may choose to refrain from prosecuting further charges."

Current legislation often recognizes noise as a nuisance, making the subjective approach the only one possible. In the development of the Ontario Model Noise Control By-Law, another concept, "clearly audible", was introduced.

Although not defined in most by-laws, a sound, for it to be offensive, must be clearly audible. It is then up to noise control officers or other persons testifying in court to explain what they mean when they say that the sound was clearly audible. For example, a person may complain about the loud playing of a radio and indicate that it was clearly audible because the words were understood easily or the melody was heard easily. A person may be able to explain how the noise interfered with sleep or the ability to carry on a conversation. Such descriptions have been accepted in a court of law. A model qualitative noise control by-law is given in Section 4.1.

Figure 3.2 Illustration of Basic Types of Sound Level Criteria



Potential noise impact	- loss of sleep/ disturbance		-hearing loss (occupational health concern)
	-loss of enjoyment of outdoors		
	-speech interference		
Types of noise assessment	-indoor/backyard	-vehicle noise emission specifications	-equipment manufacturer specifications
	-measure sound levels at point of reception	-traffic flow/speed noise modelling	-measure noise levels near source
	-qualitative or subjective noise level assessment		

The primary difference between the qualitative and quantitative approach to noise control is the extent to which monitoring equipment is used to quantify the noise levels. The quantitative approach requires the measurement of noise to provide a numerical description. This approach allows the measured level to be compared to an established standard or limit, and the degree of noise attenuation required can be established readily.

Quantitative noise assessment eliminates subjective judgment of enforcement personnel, and places the assessment of a noise source on a measurement basis. The sound level of a source is compared to criteria, established on a scientific basis, that are incorporated in regulations or by-laws. The criterion may be a noise level limit established for a stationary source, which is a composite noise source consisting of any and all individual noise sources on the premises. A certain sound emission will be allowed, and the measured excess level would be assessed as a violation.

An extension of the quantitative approach is the use of mathematical modelling to predict noise levels from a specific source or a combination of different sources. Although this approach is generally quite complex, it is most effective as a planning tool to assess the impact of a new source or receiver of environmental noise. A model quantitative noise control by-law is contained in Section 4.2.

The qualitative approach relies on the judgment of a reasonable and objective individual to assess whether a specific noise level is unacceptable or constitutes a violation. The benefit of the qualitative approach is that it does not require specialized training or equipment for enforcement.

3.2.2 Adopt Sound Level Criteria

This section outlines the three basic criteria (relative to how the sound is considered) to control noise, the sound level descriptors that may be used, and recommended point of reception sound level limits for environmental noise.

The establishment of sound level limits is one of the most crucial parts of the design of a noise control program. Table 3.3 gives recommended sound level limits. These limits also may be used as property line standards. Some source emission limits currently used by specific agencies are given in technical support documents in Section 8.

The three types of criteria are complementary elements of noise control. Point of reception or property line criteria at the receptor are intended to protect residential (or institutional) premises. Property line criteria at the source assist in planning and controlling source emission where adjacent land uses are not determined. Source emission criteria, on the other hand, provide a tool for planning new installations of equipment with noise emission potential.

Any effective noise control program requires the use of all three types of sound level criteria.

Source emission criteria require that specific products such as air conditioners and power tools meet maximum sound levels at a given distance.

The advantages and disadvantages of adopting source emission criteria follow:

Advantages

(i) Manufacturers are required to accept realistic maximum emission levels based on technically and economically feasible noise control methods for their products.

(ii) Prediction of noise impact at a given location is possible from known sound emission potential.

(iii) Actual field measurements at point of manufacture may be used to identify dominant sources in multiple noise source installations.

(iv) Pre-design comparison of products of various manufacturers may include noise emission as a selection criterion.

Disadvantages

(i) Although the noise emission criteria are fixed in terms of sound level at a specific distance, such equipment must be operated at or below the distances specified from any noise sensitive receptor to prevent resultant sound levels at the receiver from being excessive.

(ii) It is usually difficult to verify noise emission of a particular product *in situ*.

(iii) Noise emission criteria normally are based on carefully specified test conditions at the point of manufacture, which may be difficult or nearly impossible to duplicate in the field with untrained operators and less sophisticated sound measurement equipment.

Property line criteria specify maximum sound levels at the property line.

The advantages and disadvantages of adopting property line criteria follow:

Advantages

(i) Monitoring the sound emission of a particular industry is simpler, and the results could be more accurate since cumulative or total noise from the industry is considered rather than multiple individual contributing noise sources.

(ii) In the case of a noise complaint investigation at a receiver, it may be possible to determine the source of noise by taking sound level readings at the property line of nearby suspected sound emission sources. Therefore, source identification is relatively easier.

(iii) Property line criteria could be regarded as a uniform method to control noise from similar establishments. Therefore, the effectiveness and efficiency of noise control practices can be compared between establishments.

Disadvantages

(i) Modelling or measurement of property line sound levels could be difficult when several sources of noise exist within the premises.

(ii) Predictive modelling can be difficult due to varying field conditions between the source and the receiver.

Point of reception criteria call for the control of environmental noise exposure at the location where people are likely to be affected by noise. The advantages and disadvantages of point of reception criteria follow:

Advantages

(i) This method best ensures that the cumulative effect of nearby sources does not exceed the objective sound level. In other words, acceptable sound levels are set to suit human activities, and then extended toward meeting the objectives at the point of reception.

(ii) Monitoring could be relatively easy, since measurements could be taken directly at the point of reception.

Disadvantages

(i) Additional sound level readings need to be taken to evaluate the contribution in cases where more than one source of noise is involved.

(ii) Additional calculations must be performed to take ambient noise into account.

3.2.3 Sound Level Descriptors

The choice of the appropriate sound level descriptors must be considered carefully to reflect the degree of annoyance resulting from environmental noise. Such considerations must include the specific characteristic of the noise stimulus and the relevancy to the noise receptor. Table 3.2 summarizes various sound level descriptors and their applications. The first four descriptors generally are used in by-laws and the other four in planning descriptors.

Control of environmental noise in certain situations (e.g., outdoor recreational areas) requires assessing the long-term average sound level during daytime instead of using a 24-hour average. This latter measure includes the nighttime sound level that has no direct relevancy to people's activities in these situations. Conversely, to design sleeping quarters, it is important to consider the sound level during the applicable nighttime period. This measure should result in a more appropriate estimate of the degree of impact on people involved in indoor activities during the evening or during sleeping hours. Care must be taken that the data examined accurately reflect the situation being examined and that all calculations are accurate. The result must be a true representation of the situation.

Table 3.2 Sound Level Descriptors and Their Applications

Descriptor	Time Period	Application(s)
dB - peak	-N/A (peak pressure level)	-Quarry blasting -Frequency analysis of specific noise
dBa - peak	-N/A (peak weighted pressure level)	-Sound emission standards of specific equipment
dBAI	-N/A (instantaneous impulse response)	-Impulsive noise from specific industrial operations
L_{Aeq1h}	1 hour	-Abatement of industrial and commercial sources of noise -Approval of new sources of noise
L_{Aeq8h}	8 hours (23:00-07:00)	-Control of noise in noise-sensitive land uses during nighttime (design of sleeping and living quarters)
L_{Aeq16h}	16 hours (07:00-23:00)	-Control of noise in noise-sensitive land uses during daytime (design of outdoor recreation areas)
L_{Aeq24h}	24 hours	-Control of noise in noise-sensitive land uses in general
NEF	24 hours - based on the 95th percentile of the number of daily aircraft movement for the forecast year	-Control of aircraft noise in noise-sensitive areas by encouraging compatible land use planning in the vicinity of airports

For transportation noise sources, the 24-hour Leq has the advantage over the other Leq-based measures since it does not require information on the day-night split of operation of the source, and is therefore simpler to estimate. (Traffic departments traditionally provide daily traffic volumes.) If actual field measurements are taken, this advantage is irrelevant. There are also few data on community response as a function of shorter duration noise levels. However, short-term noise sources (e.g., power lawn mower, operated for an hour one day per week in a quiet residential neighbourhood), will not raise the 16-hour Leq at adjacent residences to levels which the road or aircraft data indicate are necessary to cause a problem. The power lawn mower may, nonetheless, cause annoyance. Therefore, its noise potential could be estimated only using short-term sound level readings based on peak pass-by level to give a reasonable indication of the sound emission potential of such equipment.

One particular noise source is an airport where a special descriptor is based on an energy average over a 24-hour period, although the data are essentially the average daily levels based on one year's or several years' data.

Aircraft Noise Exposure Forecast (NEF) contours are estimated using a "planning day". Planning days are approximated by calculating the average number of aircraft movements on the 21 busiest days in each of some number of the previous years. From these averages, the planning day for the NEF forecast year is projected, based upon the expected total annual number of aircraft movements for that year.

Although several descriptors may be applied to assessing a single noise source, it is suggested that legislators apply a minimum number of descriptors. Ideally, all descriptors used in a noise program should be applicable in all legislative approaches (i.e., land use planning, source noise control and abatement). This practice would cause the least difficulty in implementation. Presently, the one-hour Leq descriptors are recommended for most abatement and planning considerations.

Table 3.3 contains recommended point of reception limits for various locations. They are based on scientific, practical and acoustical considerations, and the limits selected are considered to be flexible. The scientific principles behind their selection include the effects of noise on sleep, intrusiveness, present ambient noise levels in an urban environment and task disturbance. It is hoped that the publication of this table will encourage the use of uniform limits across Canada while, at the same time, leave some flexibility for quieter areas where lower limits are practical and achievable.

3.2.4 Develop Policies and Procedures

It is prudent that details of the noise control program administered by any jurisdiction be outlined in a clear and concise manner to serve as a primary reference to government officials, the consulting industry and the public. Examples of such publications are found in References On 77, On 80, Al 80c, Al 84a, and Al 84b.

Table 3.3 Recommended Point of Reception Sound Level Limits (dBA)

General

Location	Time	Sound level limit (Leq) at point of reception (dBA) over time period specified on left
Surburban outdoor areas	23:00-07:00	50
Surburban outdoor recreational areas	07:00-23:00	55
Indoors: Bedrooms, sleeping quarters, hospitals, etc.	23:00-07:00	40
Indoors: Living rooms, hotels, motels, etc.	07:00-23:00	45
Indoors: Private offices, classrooms, reading rooms, small conference rooms, etc.	07:00-23:00	45
Indoors: General offices, reception areas, retail shops, etc.	07:00-23:00	50

Stationary Sources

Type of noise	Sound level limit at point of reception (dBA)
Steady noise	Leq/h due to road traffic noise increase (Leq/h of less than 40 dBA not considered)
Specific impulsive sounds	50 dBAI
Firearms	50 dBAI
Pest control devices	70 dBAI 60 dBA Leq 1h

Such documents must outline the review and enforcement procedures of various components of the noise control program. These publications might include the following: planning, abatement and audit procedures.

3.2.4.1 Planning

The following planning process procedures may be useful to administer the planning segments of a noise control program.

When plans for a new source or new receivers are submitted for review, the first step is that the approving agency prepare initial comments. The comments should establish anticipated noise levels for the site and be compared with the objective sound levels. This examination should indicate the existence and extent of the noise problem. At this stage, it should not be necessary to investigate detailed noise abatement or control measures.

The next step is to prepare guidelines issued by the approving authority to inform development proponents, architects, consultants and contractors about what data must be provided for the initial review. These guidelines should include acceptable prediction techniques. Approving staff should have computerized prediction methods to perform rapid and accurate sound level predictions.

These techniques enable staff with minimum training in noise level assessment to respond quickly to proposals that have potential to create noise conflict between a source and a receiver. Section 6 addresses noise measurements and predictions.

It is recommended that the task of designing acceptable noise control measures for specific sites be left to the proponent who can be assisted considerably by documents and references from the approving agency. Discussions may have to be arranged among the approving authority, the developer and the consultant to institute agreed-upon noise control measures.

There may be special circumstances in which the proponent of a new source or receiver may need to negotiate with existing sources or receivers, or in which the control agency may have such interest, in order to implement the most effective measures. Planning is discussed in more detail in Section 5.

Abatement

The function of investigating noise complaints and abatement of existing noise problems may be shared between the various levels of government. This participation will depend on the development of specific arrangements to suit local needs and resources.

The following procedures may prove useful to prepare an abatement program. The initial field investigation should establish the validity of the complaint by subjective evaluation. In this step, preliminary noise measurements are taken at the point of reception, often using portable hand-held sound level meters.

These details should be documented: operation of the source, nature of the complaint, and relationship between the complaint and activity creating the problems.

During this initial field investigation, area plans, sketches and/or photographs should be prepared showing the relationship of the noise source, transmission path and point of reception. The experienced investigator should be able to determine the degree of complexity of the problem, and the need for additional measurements requiring specialized equipment and/or expertise. The technical report then should be prepared to include: time and date of measurements, individuals responsible for the investigation, technical procedures, type and serial number of equipment used, environmental conditions, measurement location(s), and results and conclusions involving land use zones.

The noise producer and the receiver should be advised of the investigation results based on findings of the technical report. A document responding to concerned parties should include: applicable criteria, recommended course of action and, if necessary, the need for additional detailed investigation by consultants specialized in the field to be retained by the source owner/operator, and the schedule to complete the abatement work.

3.2.4.2 Audit Program

An audit procedure may be useful to check the effectiveness of a noise control program by observing past activities, and monitoring the results in both the abatement and planning areas.

Noise abatement measures refer to the lowering of sound levels in cases where both the source of noise and the receiver co-exist; noise control measures refer to situations involving a planned new source of noise or a new receiver. The methods and common approaches are discussed in Section 7.

3.2.5 Develop Training Programs

Regulators must specify minimum training requirements for individuals responsible for various aspects of a noise program. In particular, those responsible for enforcing legislation should be trained adequately, able to investigate and assess problems, and credibly present cases before courts of law.

The primary focus of training should be the strict enforcement of the noise control legislation. Resolving the noise problem by technical means is primarily the responsibility of the source owner or the developer of new receivers.

Training programs should be designed to:

(i) reach the broad range of disciplines involved in the program

(ii) enable participants to identify and document problems/violations

(iii) demonstrate common noise control and abatement methods and their pitfalls

(iv) provide practical training (workshops, field work, case studies)

(v) familiarize participants with the legislation.

Trained individuals must be recognized with certificates of competency having some legal standing. In Ontario, for example, Noise Control Officers, after undergoing a series of training courses, must possess a valid certificate signed by the Ontario Ministry of the Environment.

Provincial and municipal noise legislation should address the minimum certification requirements of enforcement officers. Such legislation should specify required courses, certificate renewals, course exemptions, audiometric testing and training manuals.

4. Model Noise Control Legislation

Sample model noise control by-laws are included in this section. These by-laws may be enacted by individual municipalities provided that provincial enabling legislation exists. Although an individual municipality may modify specific clauses of the sample by-laws to suit its needs, in general it is recommended that the individual clauses be adopted as written to encourage greater uniformity in applying municipal noise control by-laws throughout Canada. In turn, this procedure should enhance their enforceability. Sample by-law forms incorporating provincially applicable legislation could be prepared by provincial agencies to assist municipalities.

Maximum enforcement of noise control by-laws occurs at the municipal level. If noise control requirements contained in by-laws were to be incorporated in provincial regulations, then the provincial agency would be responsible for applying the regulations. This enforcement may be inefficient due to the resources required, and ineffective because the municipality is best suited to address local noise issues. However, the degree of efficiency or effectiveness of one or the other has to be decided in the local context.

The legislative approaches to noise control are outlined in Section 3.2.1, and should be considered in evaluating the approach best suited to the local application. Both a qualitative and a quantitative (or comprehensive) by-law are presented. Individual municipalities should decide which approach meets their needs. A general consideration should be to allow for public consultation when drafting and implementing noise control by-laws.

Municipal noise control by-laws could contain specific types of clauses that:

(i) prohibit activities at all times

(ii) prohibit defined activities by time and place in the community

(iii) control certain machinery noise by sound level limits which may be a function of time and place in the community, and a function of the point of measurement or point of reception

(iv) control the sale, rental and use of noise-producing devices by specifying noise emission limits and labelling

(v) exempt certain activities at the discretion of council such as emergency situations and traditional community activities

(vi) prohibit continuation of undesirable activities, which have been defined through an earlier conviction in a court of law, under threat of contempt of law proceedings or by injunction.

It is important to note that the above types of clauses do not involve questions of health or require the aid of acoustic professionals for enforcement. For these types of prohibitions, enforcement at the local municipal level should depend entirely on being able to prove to the court that a specific infraction has occurred. Evidence should be based on the subjective testimony of qualified witnesses and/or use of trained (and preferably certified) personnel when noise measurement techniques are prescribed in legislation or by-laws.

Figure 4.1 illustrates the basic components of the model noise control by-laws, and also shows the different components applicable to the qualitative (subjective) approach and the quantitative (comprehensive) approach.

The following model noise control by-laws have been adapted from the Model Municipal Noise Control By-Law developed by the Ontario Ministry of the Environment (Ontario 1978a). The Ontario Model Municipal Noise Control By-Law has undergone careful technical review, and municipal by-laws based on this model have proven their enforceability in the courts.

Care has to be taken to make correct reference to applicable provincial legislation when applying by-laws to specific municipalities. Quantitative by-laws also require the setting of sound level limits or sound emission standards.

Users of these National Guidelines may review the technical support documents summarized in Section 8 and other related documents, as well as adopt tried and tested approaches such as those in the Ontario Noise Pollution Control documents that may be followed verbatim or modified as required. When establishing various specified maximum sound level criteria, the intent of the noise control legislation should not be compromised, or made so rigid that it is impossible to achieve or enforce.

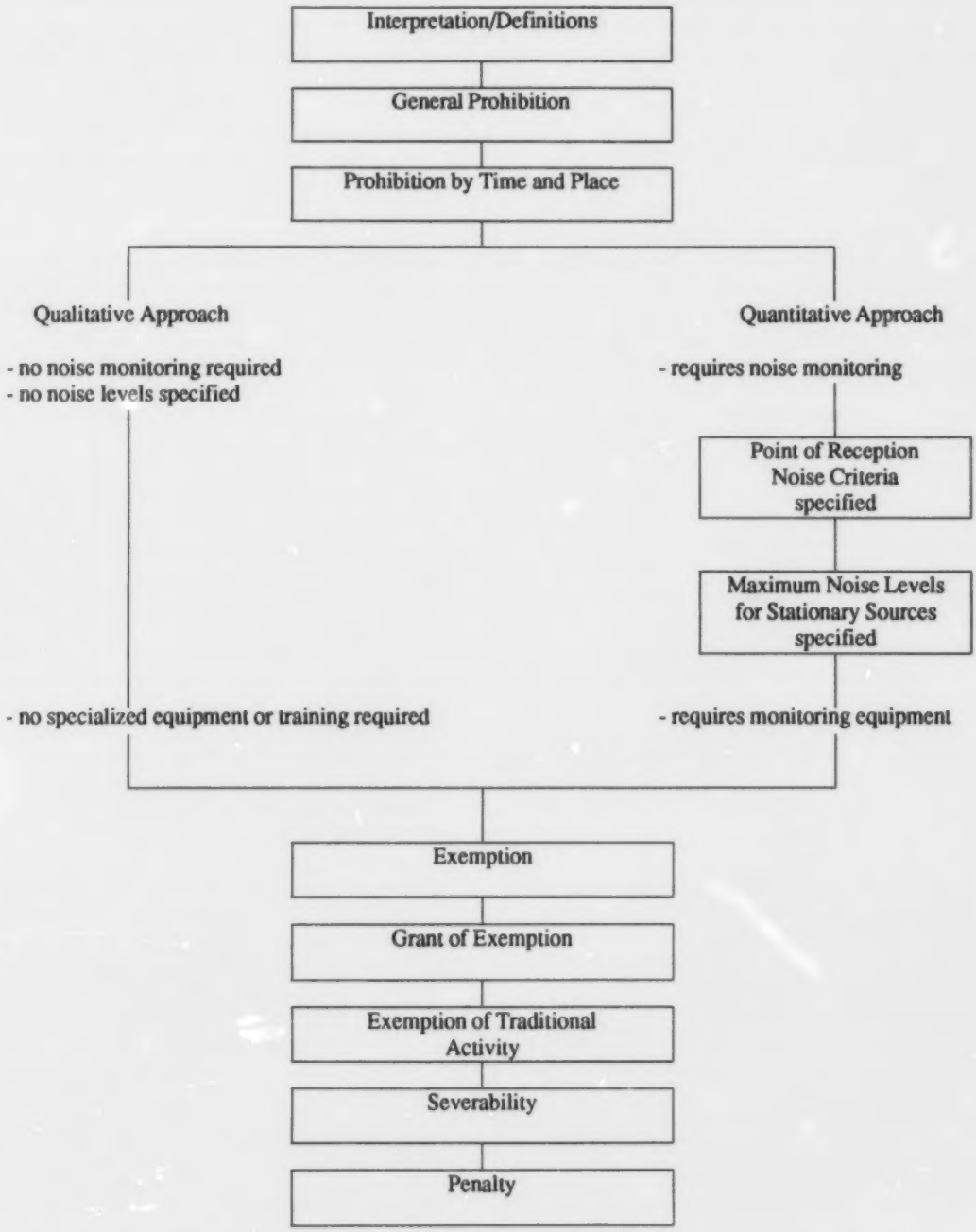
The technical support documents summarized in Section 8 reflect extensive discussion between control agencies and the manufacturers and users related to the specific noise sources. To promote uniformity and take advantage of the respective provincial agency's experience, it is recommended that similar documents be adopted for national use. As various provinces develop further experience and draft applicable documents, this material will be considered for incorporation into future revisions of these National Guidelines.

4.1 Qualitative Noise Control By-Law

Instructions for completing a qualitative municipal noise control by-law

The qualitative by-law is simple and explicit, easy to implement and enforce, and requires no special funding or training of enforcement staff.

Figure 4.1 Model Noise Control By-Law Components



The following by-law form may be used in preparing a suitable municipal noise control by-law. Appropriate information should be inserted at the places indicated. The following step-by-step instructions will assist in correct completion.

1. *Title page: Insert full legal name of municipality in two locations. Add by-law number.*
2. *Paragraph 1(1): Insert full legal name of municipality in appropriate spaces when defining terms such as council and municipality.*

3. *Paragraph 1(2): Define noise zones omitting (c) if not applicable. If zone description is lengthy or if a map is used, add this information as a separate schedule.*
4. *Paragraph 3: Insert appropriate time code or actual hours of prohibition. Provisions and contents of this section may be adjusted to suit local conditions.*
5. *Table 3-1: As before. If time code is used instead of actual hours of prohibition, insert key to code at bottom of by-law page as in the model by-law.*
6. *Paragraphs 4-6: Exemptions. Insert list of all exempted activities in Paragraph 6.*
7. *Paragraph 8: Complete where indicated under Paragraph 8. The penalty should be amended to conform with the current provisions of the Summary Convictions Act, or other similar applicable provincial legislation.*
8. ***Deletions and additions:** Flexibility is provided in the model by-law for local preferences regarding noise sources to be controlled and times when noise making is prohibited. Paragraphs 2 and 3 may be expanded or reduced to provide for local needs. References to inserts and additional sheets are helpful also.*
9. ***Consultation:** For assistance in preparing a suitable noise control by-law, and for technical and legal review, contact the appropriate provincial noise control agency. Provincial agency staff should be available to make a presentation on the noise by-law to members of council.*
10. ***Approval in principle:** It is suggested that the noise control by-law be reviewed by staff of the provincial agency prior to submitting it for formal approval by council.*

QUALITATIVE NOISE CONTROL BY-LAW

A BY-LAW TO CONTROL NOISE

By-Law No. _____

A By-Law of the Corporation of _____
(legal name of municipality)

WHEREAS it is expedient to exercise the power conferred upon the Council by _____, as amended, and other statutory authority; and
(appropriate provincial legislation)

WHEREAS a recognized body of scientific and technological knowledge exists by which sound and vibration may be substantially reduced; and

WHEREAS the people have a right to and should be ensured an environment free from unusual, unnecessary, or excessive sound or vibration which may degrade the quality and tranquility of their life or cause nuisance; and

WHEREAS it is the policy of the Council to reduce and control such sound or vibration;

NOW THEREFORE, the Council of the Corporation of _____ enacts as follows:
(legal name of municipality)

1. **Interpretation**

(1) In this by-law,

NOTE: It is suggested that the following terms, if used in the by-law, be defined, using Glossary of Terms and Interpretations in Section 9+. Care must be taken that terms that have already been defined in the enabling legislation are not redefined.

(a) Construction
(b) Construction Equipment
(c) Conveyance
(d) Council
(e) Highway
(f) Minister
(g) Ministry
(h) Motor Vehicle
(i) Motorized Conveyance
(j) Municipality
(k) Noise
(l) Point of Reception

(2) **Zones**

In this by-law,

(a) **Residential Area**

"Residential Area" means those areas of the municipality specified as follows:

(b) **Quiet Zone**

"Quiet Zone" means those areas of the municipality specified as follows:

(c) **Agricultural Area**

"Agricultural Area" means those areas of the municipality specified as follows:

2. **General Prohibitions**

No person shall emit or cause or permit the emission of sound resulting from an act listed herein, and which sound is clearly audible at a point of reception:

(1) Racing of any motorized conveyance other than in a racing event regulated by law.

(2) The operation of a motor vehicle in such a way that the tires squeal.

(3) The operation of any combustion engine or pneumatic device without an effective exhaust or intake muffling device in good working order and in constant operation.

(4) The operation of a vehicle or a vehicle with a trailer resulting in banging, clanking, squealing or other like sounds due to improperly secured load or equipment, or inadequate maintenance.

(5) The operation of an engine or motor in, or on, any motor vehicle or item of attached auxiliary equipment for a continuous period exceeding five minutes, while such vehicle is stationary in a Residential Area or a Quiet Zone unless:

(i) the original equipment manufacturer specifically recommends a longer idling period for normal and efficient operation of the motor vehicle in which case such recommended period shall not be exceeded; or

(ii) operation of such engine or motor is essential to a basic function of the vehicle or equipment including, but not limited to, operation of ready-mixed concrete trucks, lift platforms and refuse compactors; or

(iii) weather conditions justify the use of heating or refrigerating systems powered by the motor or engine for the safety and welfare of the operator, passengers or animals, or the preservation of perishable cargo, and the vehicle is stationary for purposes of delivery or loading; or

(iv) prevailing low temperatures make longer idling periods necessary immediately after starting the motor or engine; or

(v) the idling is for the purpose of cleaning and flushing the radiator and associated circulation system for seasonal change of antifreeze, cleaning of the fuel system, carburetor or the like, when such work is performed other than for profit.

(6) The operation of a motor vehicle horn or other warning device except where required or authorized by law or in accordance with good safety practices.

(7) The operation of any item of construction equipment in a Quiet Zone or Residential Area without effective muffling devices in good working order and in constant operation.

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3. **Prohibitions by Time and Place**

No person shall emit or cause or permit the emission of sound resulting from any act listed in Table 3-1 if clearly audible at a point of reception located in an area of the municipality within a prohibited time shown for such an area.

Table 3-1 Prohibitions by Time and Place

		Prohibited Period of Time	
		Quiet Zone	Residential Area
1.	The detonation of fireworks or explosive devices not used in construction.	At all times	At all times
2.	The discharge of firearms.	At all times	At all times
3.	The operation of a combustion engine which, (i) is, or (ii) is used in, or (iii) is intended for use in, a toy or a model or replica of any device, which model or replica has no function other than amusement and which is not a conveyance.	At all times	At all times
4.	The operation of any electronic device or group of connected electronic devices incorporating one or more loudspeakers or other electro-mechanical transducers, and intended for the production, reproduction or amplification of sound.	At all times	C
5.	The operation of any auditory signalling device, including but not limited to, the ringing of bells or gongs and the blowing of horns or sirens or whistles, or the production, reproduction or amplification of any similar sounds by electronic means except where required or authorized by law or in accordance with good safety practices.	At all times	D and E
6.	The operation of any powered rail car including but not limited to refrigeration cars, locomotives or self-propelled passenger cars, while stationary on property not owned or controlled by a railway governed by the Canada Railway Act.	At all times	B
7.	The operation of any motorized conveyance other than on a highway or other place intended for its operation.	At all times	B
8.	The venting, release or pressure relief of air, steam or other gaseous material, products or compound from any autoclave, boiler, pressure vessel, pipe, valve, machine, device or system.	At all times	A
9.	Persistent barking, calling or whining or other similar persistent noise making by any domestic pet or any other animal kept or used for any purpose other than agriculture.	At all times	A
10.	The operation of a commercial car wash with air drying equipment.	At all times	D and E
11.	Yelling, shouting, hooting, whistling or singing.	At all times	A

Table 3-1 (Cont.)

		Prohibited Period of Time	
		Quiet Zone	Residential Area
12.	The operation of a power-assisted hand glider or parafoil.	At all times	D and E
13.	The operation of any item of snow-making equipment.	At all times	E
14.	All selling or advertising by shouting or outcry or amplified sound.	At all times	D and E
15.	Loading, unloading, delivering, packing, unpacking, or otherwise handling any containers, products, materials, or refuse, whatsoever, unless necessary for the maintenance of essential services or the moving of private household effects.	D and E	D and E
16.	The operation of any equipment in connection with construction.	D and E	D and E
17.	The operation or use of any tool for domestic purposes other than snow removal.	C	B
18.	The operation of solid waste bulk lift or refuse compacting equipment.	C	B
19.	The operation of a commercial car wash of a type other than mentioned in item 10.	C	A

Prohibited Periods of Time:
A - 2300 one day to 0700 next day (0900 Sundays)
B - 1900 one day to 0700 next day (0900 Sundays)
C - 1700 one day to 0700 next day (0900 Sundays)
D - All day Sundays and statutory holidays
E - 1900 one day to 0700 next day.

4. **Exemption**

Public Safety

Notwithstanding any other provision of this by-law, it shall be lawful to emit or cause or permit the emission of sound or vibration in connection with emergency measures undertaken:

(a) for the immediate health, safety or welfare of the inhabitants or any of them; or
(b) for the preservation or restoration of property; unless such sound or vibration is clearly of a longer duration or nature more disturbing than is reasonably necessary for the accomplishment of such emergency purpose.

5. **Grant of Exemption by Council**

(1) **Application to Council**

Notwithstanding anything contained in this by-law, any person may make application to Council to be granted an exemption from any of the provisions of this by-law with respect to any source of sound or vibration for which he might be prosecuted and Council, by resolution, may refuse to grant any exemption or may grant the exemption applied for or any exemption of lesser effect and any exemption granted shall specify the time period, not in excess of six months, during which it is effective and may contain such terms and conditions as Council sees fit.

(2) **Decision**

In deciding whether to grant the exemption, Council shall give the applicant and any person opposed to the application an opportunity to be heard and may consider such other matters as it sees fit.

(3) **Breach**

Breach by the applicant of any of the terms or conditions of any exemption granted by Council shall render the exemption null and void.

6. **Exemption of Traditional, Festive or Religious Activities**

Notwithstanding any other provision of this by-law, this by-law does not apply to a person who emits or causes or permits the emission of sound or vibration in connection with any of the listed traditional, festive, religious and other activities.

7. **Severability**

If a court of competent jurisdiction should declare any section or part of a section of this by-law to be invalid, such section or part of a section shall not be construed as having persuaded or influenced Council to pass the remainder of the by-law and it is hereby declared that the remainder of the by-law shall be valid and shall remain in force.

8. **Penalty**

Every person who contravenes any of the provisions of this by-law is guilty of an offence and shall, upon conviction thereof, forfeit and pay a penalty of not more than $1,000.00 for a first offence and not less than $100.00 and not more than $1,000.00 for a second or subsequent offence, exclusive of costs and every such fine is recoverable under_____. (Summary Convictions Act or other applicable provincial legislation.)

READ A FIRST AND SECOND TIME THIS day of 19 .
READ A THIRD TIME AND FINALLY PASSED THIS day of 19 .

_____ _____
MAYOR CLERK

I hereby certify the foregoing to be a
complete and true copy of By-Law Number

_____
CLERK

This By-Law is approved pursuant to the
provisions of _____Act,
at _____, this _____,
day of 19 .

_____
(MINISTER OF THE ENVIRONMENT)

or other provincially applicable approving authority

4.2 Quantitative Noise Control By-Law

Instructions for completing a quantitative municipal noise control by-law

The by-law in a quantitative form may be readily adopted, in part or in whole, by a municipal council to suit its specific noise control requirements. The responsible provincial agency will provide assistance in formulating the by-law, staff training and technical back-up as necessary during the initial period of the by-law's implementation.

The following by-law form may be used in preparing a suitable municipal noise control by-law. Appropriate information should be inserted at the places indicated. The following step-by-step instructions will assist in correct completion:

1. *Title page: Insert full legal name of municipality in two locations. Add by-law number.*
2. *Paragraph 1(2): Insert full legal name of municipality in space provided in sections 2(e) and 2(k).*
3. *Paragraph 1(3): Define noise zones omitting (3)(c) if not applicable. If zone description is lengthy or if a map is used, add this information as a separate schedule.*
4. *Paragraph 7: Insert appropriate time code or actual hours of prohibition. Provisions and contents of this section may be adjusted to suit local conditions.*
5. *Table 3-1: If time code is used instead of actual hours of prohibition, insert key to code at bottom of Table 3-1 in the model by-law.*
6. ***Deletions and additions:*** *Flexibility is provided in the model by-law for local preferences regarding noise sources to be controlled and times when noise making is prohibited. Paragraphs 2 and 3 may be expanded or reduced to provide for local needs. For the preliminary review by ministry staff, deletions could be accomplished by crossing out undesired portions, while additions could be inserted in the spaces provided. Reference to inserts and additional sheets is helpful also.*

NOTE: Although a municipality may alter some of the provisions in the text of the by-law, *alteration of the supporting technical publications (Section 8) is not recommended.* These documents represent the culmination of extensive technical research augmented and often guided by input from various government agencies, research bodies and industry.

7. ***Required format:*** *When assembling a by-law from sections of the quantitative model by-law, the following provisions apply:*
   (a) Subparagraph (1) of Paragraph 1 and Paragraph 3, "Technical Definitions" must be included without change if any of Paragraphs 4, 5 or 7 are included.
   (b) For the control of Residential Air Conditioners, the Municipality must adopt both Paragraph 4(1) and 5(1) as well as Paragraph 6.
   (c) Subparagraph (2) of Paragraph 1 and Section 7 must be included without the change, except that the definition of Noise Control Officer may be amended or altered so as to designate the Noise Control Officer by naming the office held within the municipal administration.
   (d) Subparagraph (3) of Paragraph 1 must be included in the by-law. The model suggests three noise zones that may be appropriate. Residential Area and Agricultural Area are reasonably self-explanatory. A Quiet Zone is an area, such as the site of a hospital, where quiet is of particular importance. It is permissible to delete any of these zones except Residential Area, or to specify different kinds of zones, such as Commercial or Rural Areas, if this seems advisable because of the nature of the community. Certain alterations to Paragraph 3 may be necessary depending on the municipal interpretation of such noise zones. The time restrictions in Table 3-1 are suggestions only and may be revised to suit municipal requirements. The letter code shown in the Table also may be replaced by the applicable hours.
   (e) The definitions of noise zones which are in Subparagraph (3) of Paragraph 1 must be completed by Council in such a way as to specify the geographic boundaries of each defined zone. This designation must be done by referring to zoning by-laws, and using maps or any other convenient descriptive means. If this description is lengthy, it may be desirable to have a separate schedule to the by-law.
   No new zone designations will be permitted. This noise by-law should not be used for land zoning purposes to regulate the uses that could be made of such land.
   (f) A selection from Paragraphs 2 through 7 must be made and no significant change in wording will be permitted. Additional sources of noise may be included in Paragraphs 2 and 3, subject to ministry approval.
   (g) If any of Paragraphs 4, 5 or 7 are included, all of the technical publication must be attached to, and form part of, the by-law.

NOTE: Ontario's Noise Pollution Control documents or other equivalent provincial documents can be used. The technical support documents should specify limits and necessary details for effective enforcement.

   (h) Paragraph 6 must be included if both Paragraphs 4 and 5 are selected.
   (i) The by-law must include Paragraph 8 of the model by-law or some suitable variation.
   (j) Paragraph 9 of the model by-law is mandatory regarding inclusion and precise wording.
   (k) Paragraph 10 of the model by-law is optional. If Paragraph 10 is included, it must be completed. Insert list of all exempted activities in Paragraph 10.

(l) The by-law must include Paragraphs 11 and 12 of the model by-law or some suitable variation. Complete where indicated under Paragraph 12. The penalty should be amended to conform with the current provisions of the Municipal Act (or other applicable provincial legislation).

8. ***Consultation:*** *For assistance in preparing a suitable noise control by-law, and for technical and legal review, contact the appropriate provincial noise control agency. Provincial agency staff should be available to make a presentation on the noise by-law to members of Council.*
9. ***Approval in principle:*** *It is suggested that the noise control by-law be reviewed by staff of the provincial agency prior to submitting it for formal approval by Council.*
10. ***Approval by the Minister or provincial noise control agency:*** *After adoption by Council, send an original and two certified copies of the by-law to the Minister or the provincial noise control agency for approval and signature. The original, plus one certified copy, will be returned after receiving approval.*
11. ***Administration of the by-law:*** *The by-law is administered by the Noise Control Officer designated by Council. Proper enforcement of the quantitative aspects of a by-law will require trained personnel who should be certified, where possible, in special environmental acoustics courses offered by the provincial agency.*

QUANTITATIVE NOISE CONTROL BY-LAW

A BY-LAW TO CONTROL NOISE

By-Law No. _____

A By-Law of the Corporation of _____
(legal name of municipality)

WHEREAS it is expedient to exercise the power conferred upon the Council by _____ as amended, and other statutory authority; and
(appropriate provincial legislation)

WHEREAS a recognized body of scientific and technological knowledge exists by which sound and vibration may be substantially reduced; and

WHEREAS the people have a right to and should be ensured an environment free from unusual, unnecessary, or excessive sound or vibration which may degrade the quality and tranquility of their life or cause nuisance; and

WHEREAS it is the policy of the Council to reduce and control such sound or vibration;

NOW THEREFORE, the Council of the Corporation of _____ enacts as follows:
(legal name of municipality)

1. **Interpretation**

(1) **Technical Terms**
In this by-law all the words which are of a technical nature and are related to sound or vibration shall have the meanings specified in Section 9[+] Glossary of Terms and Interpretations.

(2) **Definition**
In this by-law,
NOTE: It is suggested that the following terms, if used in the by-law, be defined using Section 9[+], Glossary of Terms and Interpretations. Care must be taken that terms already defined in the enabling legislation are not redefined.
(a) Certificate
(b) Construction
(c) Construction Equipment

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(d) Conveyance
(e) Council
(f) Highway
(g) Minister
(h) Ministry
(i) Motor Vehicle
(j) Motorized Conveyance
(k) Municipality
(l) Noise
(m) Noise Control Officer
(n) Point of Reception
(o) Publication
(p) Stationary Source

(3) **Zones**

In this by-law,

(a) **Residential Area**

"Residential Area" means those areas of the municipality specified as follows:

(b) **Quiet Zone**

"Quiet Zone" means those areas of the municipality specified as follows:

(c) **Agricultural Area**

"Agricultural Area" means those areas of the municipality specified as follows:

2. **General Prohibitions**

No person shall emit or cause or permit the emission of sound resulting from an act listed herein, and which sound is clearly audible at a point of reception:

(1) Racing of any motorized conveyance other than in a racing event regulated by law.

(2) The operation of a motor vehicle in such a way that the tires squeal.

(3) The operation of any combustion engine or pneumatic device without an effective exhaust or intake muffling device in good working order and in constant operation.

(4) The operation of a vehicle or a vehicle with a trailer resulting in banging, clanking, squealing or other like sounds due to improperly secured load or equipment, or inadequate maintenance.

(5) The operation of an engine or motor in, or on, any motor vehicle or item of attached auxiliary equipment for a continuous period exceeding five minutes, while such vehicle is stationary in a Residential Area or a Quiet Zone unless:

(i) the original equipment manufacturer specifically recommends a longer idling period for normal and efficient operation of the motor vehicle in which case such recommended period shall not be exceeded; or

(ii) operation of such engine or motor is essential to a basic function of the vehicle or equipment including, but not limited to, operation of ready-mixed concrete trucks, lift platforms and refuse compactors; or

(iii) weather conditions justify the use of heating or refrigerating systems powered by the motor or engine for the safety and welfare of the operator, passengers or animals, or the preservation of perishable cargo, and the vehicle is stationary for purposes of delivery or loading; or

(iv) prevailing low temperatures make longer idling periods necessary immediately after starting the motor or engine; or

(v) the idling is for the purpose of cleaning and flushing the radiator and associated circulation system for seasonal change of antifreeze, cleaning of the fuel system, carburetor or the like, when such work is performed other than for profit.

(6) The operation of a motor vehicle horn or other warning device except where required or authorized by law or in accordance with good safety practices.

(7) The operation of any item of construction equipment in a Quiet Zone or Residential Area without effective muffling devices in good working order and in constant operation.

3. **Prohibitions by Time and Place**

No person shall emit or cause or permit the emission of sound resulting from any act listed in Table 3-1 if clearly audible at a point of reception located in an area of the municipality within a prohibited time shown for such an area.

Table 3-1 Prohibitions by Time and Place

		Prohibited Period of Time	
		Quiet Zone	Residential Area
1.	The detonation of fireworks or explosive devices not used in construction.	At all times	At all times
2.	The discharge of firearms.	At all times	At all times
3.	The operation of a combustion engine which, (i) is, or (ii) is used in, or (iii) is intended for use in, a toy or a model or replica of any device, which model or replica has no function other than amusement and which is not a conveyance.	At all times	At all times
4.	The operation of any electronic device or group of connected electronic devices incorporating one or more loudspeakers or other electro-mechanical transducers, and intended for the production, reproduction or amplification of sound.	At all times	C
5.	The operation of any auditory signalling device, including but not limited to, the ringing of bells or gongs and the blowing of horns or sirens or whistles, or the production, reproduction or amplification of any similar sounds by electronic means except where required or authorized by law or in accordance with good safety practices.	At all times	D and E
6.	The operation of any powered rail car including but not limited to refrigeration cars, locomotives or self-propelled passenger cars, while stationary on property not owned or controlled by a railway governed by the Canada Railway Act.	At all times	B
7.	The operation of any motorized conveyance other than on a highway or other place intended for its operation.	At all times	B
8.	The venting, release or pressure relief of air, steam or other gaseous material, products or compound from any autoclave, boiler, pressure vessel, pipe, valve, machine, device or system.	At all times	A
9.	Persistent barking, calling or whining or other similar persistent noise making by any domestic pet or any other animal kept or used for any purpose other than agriculture.	At all times	A
10.	The operation of a commercial car wash with air drying equipment.	At all times	D and E
11.	Yelling, shouting, hooting, whistling or singing.	At all times	A

Table 3-1 (Cont.)

		Prohibited Period of Time	
		Quiet Zone	Residential Area
12.	The operation of a power-assisted hand glider or parafoil.	At all times	D and E
13.	The operation of any item of snow-making equipment.	At all times	E
14.	All selling or advertising by shouting or outcry or amplified sound.	At all times	D and E
15.	Loading, unloading, delivering, packing, unpacking, or otherwise handling any containers, products, materials, or refuse, whatsoever, unless necessary for the maintenance of essential services or the moving of private household effects.	D and E	D and E
16.	The operation of any equipment in connection with construction.	D and E	D and E
17.	The operation or use of any tool for domestic purposes other than snow removal.	C	B
18.	The operation of solid waste bulk lift or refuse compacting equipment.	C	B
19.	The operation of a commercial car wash of a type other than mentioned in item 10.	C	A

Prohibited Periods of Time:
A - 2300 one day to 0700 next day (0900 Sundays)
B - 1900 one day to 0700 next day (0900 Sundays)
C - 1700 one day to 0700 next day (0900 Sundays)
D - All day Sundays and statutory holidays
E - 1900 one day to 0700 next day.

4. General Limitations on Sound Levels Due to Stationary Sources

(1) No person shall emit or cause or permit the emission of sound from a stationary source such that the level of sound from that source at a point of reception located in a Quiet Zone or Residential Area exceeds the applicable sound level limit prescribed in Section 8.1+ on Stationary Sources.

(2) Subparagraph (1) does not apply to any equipment, apparatus or device used in agriculture for food crop seeding, chemical spraying or harvesting.

5. Limitation on Sound and Vibration Levels at a Point of Reception for Specific Sources

(1) Residential Air Conditioners

No person shall emit or cause or permit the emission of sound from the operation of a residential air conditioning device of a type referred to in Section 8.4+ on Residential Air Conditioners, resulting in a sound level at a point of reception located in a Quiet Zone or Residential Area in excess of the applicable sound level limit set out in Section 8.4+ on Residential Air Conditioners.

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(2) **Blasting Operations**

No person shall emit or cause or permit the emission of sound (concussion) or vibration from a blasting operation of a type mentioned in Section 8.7+ on Blasting, such that the peak pressure level or peak particle velocity at a point of reception located in a Quiet Zone or Residential Area exceeds the applicable limit set out in Section 8.7+ on Blasting.

6. **Preemption**

Where a source of sound is subject to both Sections 4 and 5, the less restrictive provisions shall prevail.

7. **Sound Emission Standards**

(1) **Construction Equipment - Residential Areas**

No person shall emit or cause or permit the emission of any sound from any item of construction equipment of a type referred to in Section 8.3+ on Construction Equipment at a work site, any part of which is located in or within 600 m of a Residential Area or a Quiet Zone, unless:

(a) the item of equipment was manufactured prior to January 1st, 1979; or

(b) the item of equipment bears a label affixed by the manufacturer or distributor which states the year of manufacture and that the item of equipment when new complies with the Residential Area sound emission standard set out in Section 8.3+ on Construction Equipment, as applicable to that type of equipment and date of manufacture; or

(c) the owner, operator, manufacturer or distributor provides proof that the item of equipment when new complied with the Residential Area sound emission standard set out in Section 8.3+ on Construction Equipment, as applicable to that type of equipment and date of manufacture.

(2) **Construction Equipment - Quiet Zones**

No person shall emit or cause or permit the emission of any sound from any item of construction equipment of a type referred to in Section 8.3+ on Construction Equipment, at a work site, any part of which is located in a Quiet Zone, unless:

(a) the item of equipment bears a label affixed by the manufacturer or distributor which states the year of manufacture and that the item of equipment when new complies with the Quiet Zone sound emission standard set out in Section 8.3+ on Construction Equipment as applicable to that type of equipment and date of manufacture; or

(b) the owner, operator, manufacturer or distributor provides proof that the item of equipment when new complied with the Quiet Zone sound emission standard set out in Section 8.3+ on Construction Equipment, as applicable to that type of equipment.

(3) **Domestic Outdoor Power Tools**

No person shall emit or cause or permit the emission of any sound in a Residential Area or Quiet Zone from any domestic outdoor power tool of a type referred to in Section 8.5+ on Domestic Outdoor Power Tools, which device is powered by an electric motor or an internal combustion engine unless:

(a) the device was manufactured prior to January 1st, 1979; or

(b) the device bears a label affixed by the manufacturer or distributor which states the year of manufacture and that the device when new complies with the sound emission standard set out in Section 8.5+ on Domestic Outdoor Power Tools, as applicable to that type of device and date of manufacture; or

(c) the owner, operator, manufacturer or distributor provides proof that the device when new complied with the sound emission standard set out in Section 8.5+ on Domestic Outdoor Power Tools, as applicable to that type of device and date of manufacture.

(4) **Air Conditioners**

No person shall emit or cause or permit the emission of any sound from any air conditioning device of a type referred to in Section 8.4+ on Residential Air Conditioners unless:

(a) the device was manufactured prior to January 1st, 1979; or

(b) the device bears a label affixed by the manufacturer or distributor which states the year of manufacture and that the device when new complies with the sound emission standard set out in Section 8.4+ on Residential Air Conditioners, as applicable to that type of device and date of manufacture; or

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(c) the owner, operator, manufacturer or distributor provides proof that the device when new complied with the sound emission standard set out in Section 8.4+ on Residential Air Conditioners, as applicable to that type of air conditioner and date of manufacture.

(5) **Motorized Conveyances**

No person shall emit or cause or permit the emission of any sound from any motorized conveyance of a type referred to in Section 8.6+ on Motorized Conveyances unless the motorized conveyance complies with the sound emission standard set out in Section 8.6+ on Motorized Conveyances, as applicable to that type of motorized conveyance and date of manufacture.

8. **Exemption**

Public Safety

Notwithstanding any other provision of this by-law, it shall be lawful to emit or cause or permit the emission of sound or vibration in connection with emergency measures undertaken:

(a) for the immediate health, safety or welfare of the inhabitants or any of them; or

(b) for the preservation or restoration of property, unless such sound or vibration is clearly of a longer duration or nature more disturbing than is reasonably necessary for the accomplishment of such emergency purpose.

9. **Grant of Exemption by Council**

(1) **Application to Council**

Notwithstanding anything contained in this by-law, any person may make application to Council to be granted an exemption from any of the provisions of this by-law with respect to any source of sound or vibration for which he might be prosecuted and Council, by resolution, may refuse to grant any exemption or may grant the exemption applied or any exemption of lesser effect and any exemption granted shall specify the time period, not in excess of six months, during which it is effective and may contain such terms and conditions as Council sees fit.

(2) **Details of Application for Exemption**

The application mentioned in subsection (1) shall be made in writing, in duplicate, and shall contain:

(a) the name and address of the applicant;

(b) a description of the source of sound or vibration in respect of which exemption is sought;

(c) a statement of the particular provision or provisions of the by-law for which exemption is sought;

(d) the period of time, of a duration not in excess of six months, for which the exemption is sought;

(e) the reasons why the exemption should be granted;

(f) a statement of the steps, if any, planned or presently being taken to bring about compliance with the by-law; and

(g) proof of publication within the preceding ten days, in a newspaper of general circulation within the Municipality, of a notice of intention to apply for an exemption to this by-law, containing the information required by clauses (a) through (e) hereof, and further stating the date upon which it is intended that application will be made to Council.

(3) **Noise Control Officer**

Council shall cause one copy of the application for exemption to be delivered to the Noise Control Officer and he shall prepare a report to Council forthwith, stating his opinion of the merits of the application and his recommendations as to terms and conditions which, in his opinion, should be imposed upon the applicant if the exemption is granted and Council will not consider the application for exemption until it has received the report of the Noise Control Officer.

(4) **Report**

The Noise Control Officer shall forward a copy of his report to the applicant at the address shown on the application by prepaid registered mail and shall, not sooner than two weeks after the mailing of the report to the applicant, submit the report to Council and shall, on request, make his report available for public inspection.

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(5) **Decision**

In deciding whether to grant the exemption, Council shall consider the application, the report of the Noise Control Officer and any written submission then received by Council and made by the applicant after receipt of the report of the Noise Control Officer and the Council may consider such other matters as it sees fit.

(6) **Breach**

Breach by the applicant of any of the terms or conditions of the exemption shall render the exemption null and void.

10. **Exemption of Traditional, Festive or Religious Activities**

Notwithstanding any other provisions of this by-law, this by-law does not apply to a person who emits or causes or permits the emission of sound or vibration in connection with any of the listed traditional, festive, religious and other activities.

11. **Severability**

If a court of competent jurisdiction should declare any section or part of a section of this by-law to be invalid, such section or part of a section shall not be construed as having persuaded or influenced Council to pass the remainder of the by-law and it is hereby declared that the remainder of the by-law shall be valid and shall remain in force.

12. **Penalty**

Every person who contravenes any of the provisions of this by-law is guilty of an offence and shall, upon conviction thereof, forfeit and pay a penalty of not more than $1,000.00 for a first offence and not less than $100.00 and not more than $1,000.00 for a second or subsequent offence, exclusive of costs and every such fine is recoverable under the _____. (Summary Convictions Act or other applicable provincial legislation.)

READ A FIRST AND SECOND TIME THIS day of 19 .
READ A THIRD TIME AND FINALLY PASSED THIS day of 19 .

_____ _____
MAYOR CLERK

I hereby certify the foregoing to be a
complete and true copy of By-Law Number

_____
CLERK

This By-law is approved pursuant to the
provisions of_____ Act,
at _____, this _____,
day of 19 .

_____
(MINISTER OF THE ENVIRONMENT)

or other provincially applicable approving authority

5. Land Use Planning

Land use planning consists of identifying community goals and objectives, and then developing means to implement the goals. This section focuses on the planning aspects of noise control, especially when dealing with land use.

The first aim of land use planning with respect to noise is to avoid noise problems and complaints by separating residential or other land uses sensitive to noise from noise sources. When incompatible land uses are unavoidable, the second aim is to design control measures to achieve the sound level limits prescribed for the land use areas in question.

Land use planning techniques to control noise are cost effective, are usually acceptable to the general public, have the potential to alleviate future land use/noise conflicts, and minimize retrofit costs if implemented early in the planning process.

Many sources of noise require consideration in land use planning processes, but the transportation sector demands particular attention. Road traffic is usually the dominant transportation noise source, with railways a close second. The network of roadways and railway tracks spreads across Canada, and much new development occurs close to these transportation corridors. Noise from roads and railways is restricted to near ground level, and can be controlled more easily than noise emitted from aircraft. Although aircraft follow noise abatement operating procedures, very limited options are available to alleviate aircraft noise other than to design quieter aircraft, and have sufficient distance between the airports with their associated flight paths and the noise-sensitive areas. This restriction places aircraft noise into a category of its own within the land use planning framework. Industrial noise is not as widespread as the other sources, but often has a variety of characteristics that, at times, makes it particularly difficult to predict.

For a noise control program in land use planning to be successful, the components of the program should be integrated carefully with the various aspects and processes involved in planning. Plans for drainage, landscape and grading are examples of other concerns which are closely associated that must be integrated with noise control during the planning and development stages.

Land use planning in Canada usually is handled by the provincial governments with delegation to regional or municipal levels in some provinces. As pointed out in the Introduction, there are specific areas where the federal government does become involved.

Several reports and technical papers have been prepared in Canada to deal with the subject of noise control in land use planning (references CM 81a, CM 81b, On 80, Al 80d, Al 79a, Al 80f, Ma 79).

5.1 Procedures

5.1.1 New Receivers of Noise

The following procedures are most suitable when dealing with individual subdivision plans requiring draft and final approvals by the approving authority. Nevertheless, they could be applied to the preparation of other planning documents such as official or master plans, any subsequent amendments and secondary or neighbourhood plans which address new receivers of noise including residential development, group homes, nursing homes or places of worship.

5.1.1.1 Initial Comments

In the early stages of a new land use proposal, noise levels for the site should be established using prediction models or existing new source survey information, and compared with the sound level criteria. This comparison should indicate whether noise is likely to be a problem. If this is the case, the extent of the problem should be apparent based on the excess above the criteria.

Initial comments normally are prepared by the first level of approving authority that has the overall responsibility for approving new development proposals. The proponent and other government officials will be alerted to the need for detailed noise studies prior to making a commitment for draft approval. Initial comments are cost-effective since they may exempt a proponent from the cost of an acoustical study when it is obvious that there is no noise problem.

With the exception of fixed-site 24-hour airport noise monitoring systems, 24-hour monitoring of noise levels generally is a time-consuming operation which could require extensive travelling, and should be used only where no accurate techniques to predict noise are available. For railway and highway noise, such predictive techniques are readily available and, based on reliable input data, should be fully used. The subject of prediction models is discussed in Section 6. Wherever possible, the approving agencies should have access to computer models to perform rapid and accurate sound level predictions. Printed records of all input data and predicted sound levels should be available for record purposes. A sample computer output is shown in Tables 5.1 and 5.2.

Standard letters should be written to cover the various noise problems encountered to streamline the initial comments procedure. As these letters often may be sent to non-technical planning staff, some subjective assessment of the magnitude of the noise problem should be included. A sample of such initial comment report forms is shown in Figure 5.1.

Table 5.1 Sample Computer Output - Train Noise Prediction

Name of the Department

User's Name: Joe Smith Metric Measurement Systems
Date: July 7, 1986
Project: Main Street Subdivision
File No.: W86-201

Daytime Trains (0700 - 2300)								
No. of Trains	Train type	Speed	Distance	Locomotives per train	Cars per train	dBA Level		
						Wheel	Locomotive	Combined
15	passengers	80	15	2	10	58.8	62.2	63.9
32	freight	60	15	4	120	71.0	70.6	73.8
4	switches	40	15	1	4	44.1	49.3	50.4
TOTALS						71.3	71.2	74.3

Sound levels calculated in dBA are one hour L_{eq}.

The action to be taken and the process to be followed, depending on the magnitude of the excess of sound levels above sound level standards, are illustrated schematically in a flow chart, Figure 5.2, and in Table 5.3. Both examples were taken from the Ontario practice, where the province maintains a Noise Assessment Unit as a central technical advisory group. Measurement of noise from sources that otherwise could not be predicted is the duty of the proponent.

5.1.1.2 Investigation and Approval

The responsibility to recommend and design the necessary control measures in connection with a specific proposal is left to the developer and his/her consultants. Discussions, however, may well have to be arranged between the proponent, the consultant and the municipality. The developer is requested to provide a written undertaking for the specific noise control measures. Parties concerned with other non-acoustical aspects may be called on to assist with other matters such as esthetics, fire access or drainage as they impact on the acoustical design of the proposal. Compromises may be needed in such circumstances.

Depending on the excess of predicted sound levels above the pertinent sound level limits, the proponent should be asked to prepare either a "feasibility study" and/or a "detailed acoustical study". The feasibility study contains an examination of the potential of noise control measures required to achieve compliance. The feasibility study may take the form of a letter or a report depending on the complexity of the proposed development. It is not necessary to work out the exact height of sound barriers or the acoustical performance of different building components. A brief review of the actions to be taken by the developer is requested. To facilitate the review of feasibility studies, a sample form, Checklist of Requirements for Feasibility Studies - Noise Control in Land Use Planning, is included as Table 5.5.

The detailed acoustical study should contain sufficient details to enable the review agency to check all the design parameters. The *specific* course of action to be taken by the proponent will have to be examined in detail at this stage. Detailed and specific noise control measures such as building components and air conditioning must form part of the detailed acoustical study. The acoustical consultant should explain these measures in terms readily understood by technical staff without extensive training in noise. The organized summary of recommendations contained in the detailed acoustical study also could be lifted and inserted into various formal agreements and plans. The sample form, Checklist of Requirements for Detailed Acoustical Reports - Noise Control in Land Use Planning, included in Table 5.6 could be used by staff of the approving authority to evaluate the completeness of submitted reports.

5.1.1.3 Plans and Agreements

The detailed noise control measures recommended by the consultant and approved by the authority then would be incorporated into either site plans (where features such as differential in elevations, grading plans, sound barrier berms, walls, building location, building orientation and the overall layout could be incorporated), or legal agreements (where subdivision agreements and other legal forms could be registered on the title of the land under consideration).

Table 5.2 Sample Computer Output - Road Noise Prediction (On 86b)

Ministry of the Environment, Noise Assessment Unit
Noise Prediction Model, STAMSON 1.1

User:	MOE
Job Description:	Sample
Date:	02/24/87

Input Parameters:		Input File: STAMSON
Measurement Unit	—	Metric
Number of Roadway Elements	—	1

Roadway Element #1

Roadway Parameters:			
Car Volume	—	910	vph
Medium Truck	—	20	vph
Heavy Truck	—	70	vph
Gradient (%)	—	0.0	
Post Speed Limit	—	80	km/h
Pavement Type	—	Typical Asphalt	
Topography and Layout:			
Roadway Size: Angle 1	—	-90	degrees
Angle 2	—	90	degrees
Intermediate Ground Surface	—	Absorptive	
Source-Receiver Distance	—	30.0	metres
Source Height above Roadway	—	1.6	metres
Receiver Height above Ground	—	1.5	metres
Roadway Elevation	—	0.0	metres
(Roadway Elevation Is Relative to Receiver Ground Elevation)			
Shielding:			
Depth of Woods	—	NA	
Number of Rows of Houses	—	NA	
Density of First Row	—	NA	
Barrier:			
Angle A1	—	NA	
Angle A2	—	NA	
Barrier-Receiver Distance	—	NA	
Barrier Height	—	NA	

	Sub-Element
Layout	1
Angle 1	-90
Angle 2	90
Reference L_{eq1h}	73.2
Adjustment	
Distance	-4.5
Finite element	-1.2
Pavement	0.0
Shielding Adjustment	
Woods	
Houses	
Barrier	
Total shielding	
Sub-Element L_{eq1h}	67.5
Element L_{eq1h}	67.5
Total L_{eq1h} (all elements)	67.5 dBA

Figure 5.1 Sample Initial Comments Report

Noise: Impact Assessment

Date:_____

To: _____

_____

_____

From:

Subject: _____

_____

_____

_____

Noise Source:

Trains ☐ Traffic ☐ Aircraft ☐ Industry/Commercial ☐

Predicted Excess _____ dBA or _____ NEF Due to _____
(Noise Source)

During: Day ☐ Night ☐ 24 Hours ☐

Magnitude of Noise Problem: Slight ☐ Definite ☐ Serious ☐

Very Serious ☐

Recommend:

Draft approval subject to

No Conditions (No Excess) ☐ Warning Clause on Lots _____ (Excess 1-5 dBA) ☐ Three Standard Conditions (Excess 6-10 dBA) ☐

or feasibility study required prior to draft approval ☐

Information Used in Prediction:_____

_____

_____

_____

_____

_____

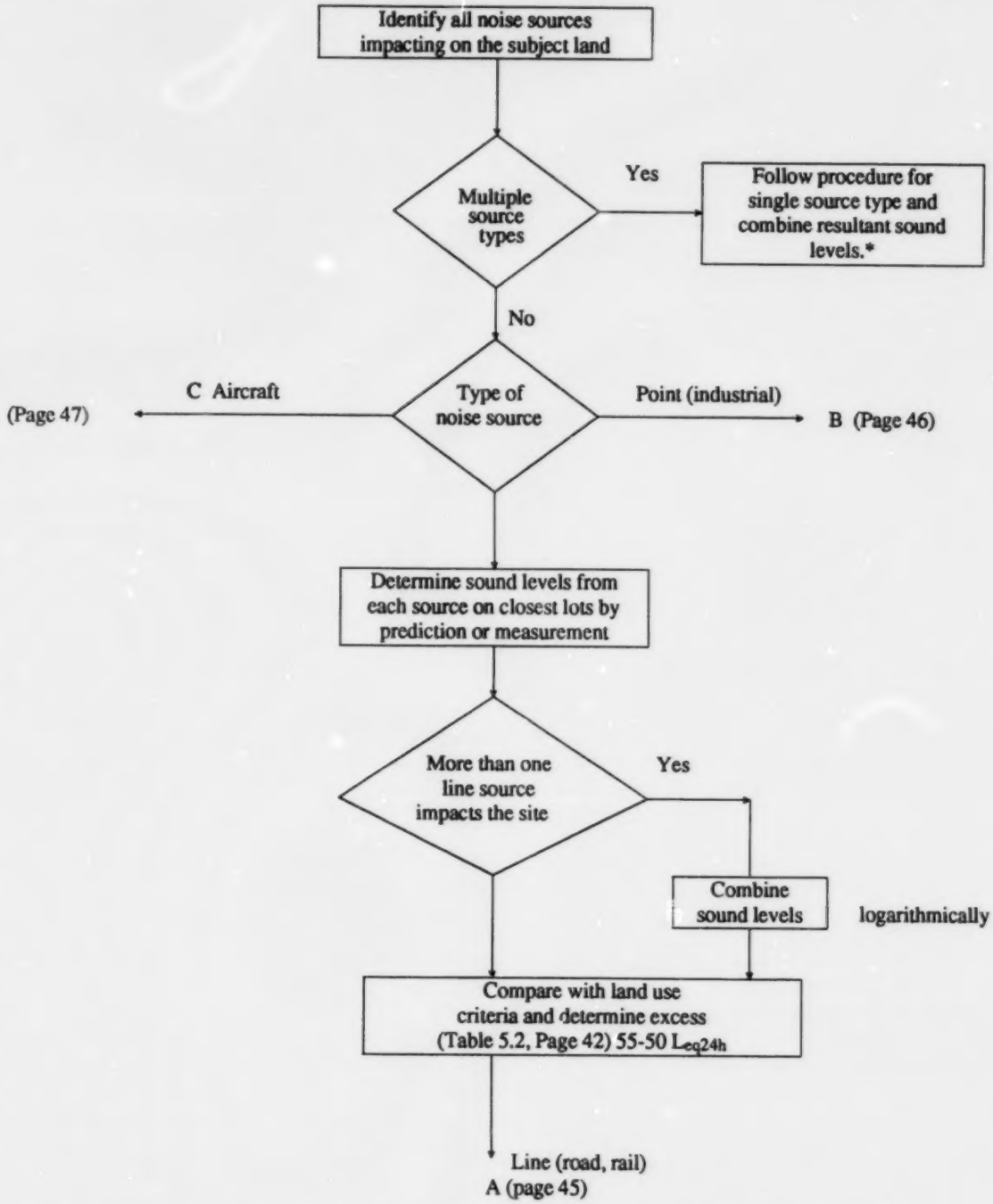
_____

_____

Please Send a Copy of Your Response to:_____

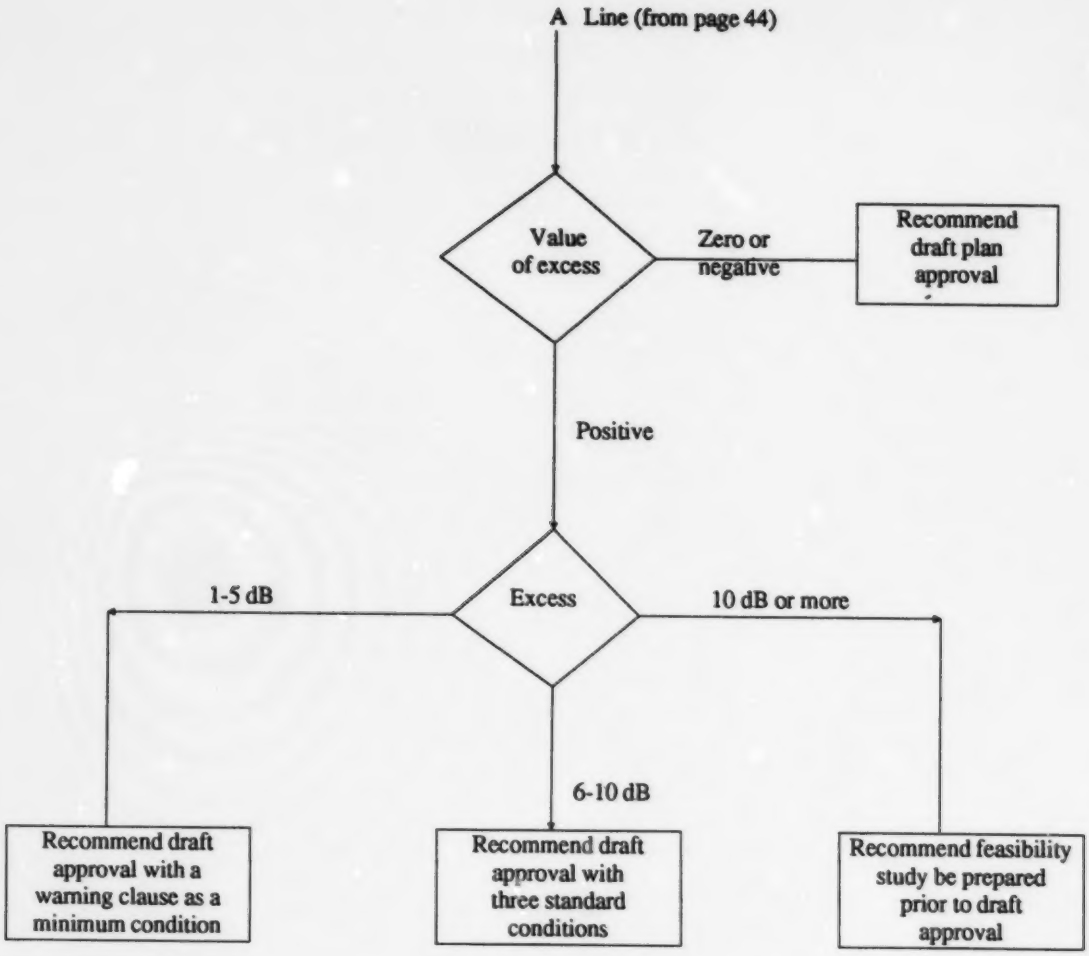
Signature:_____

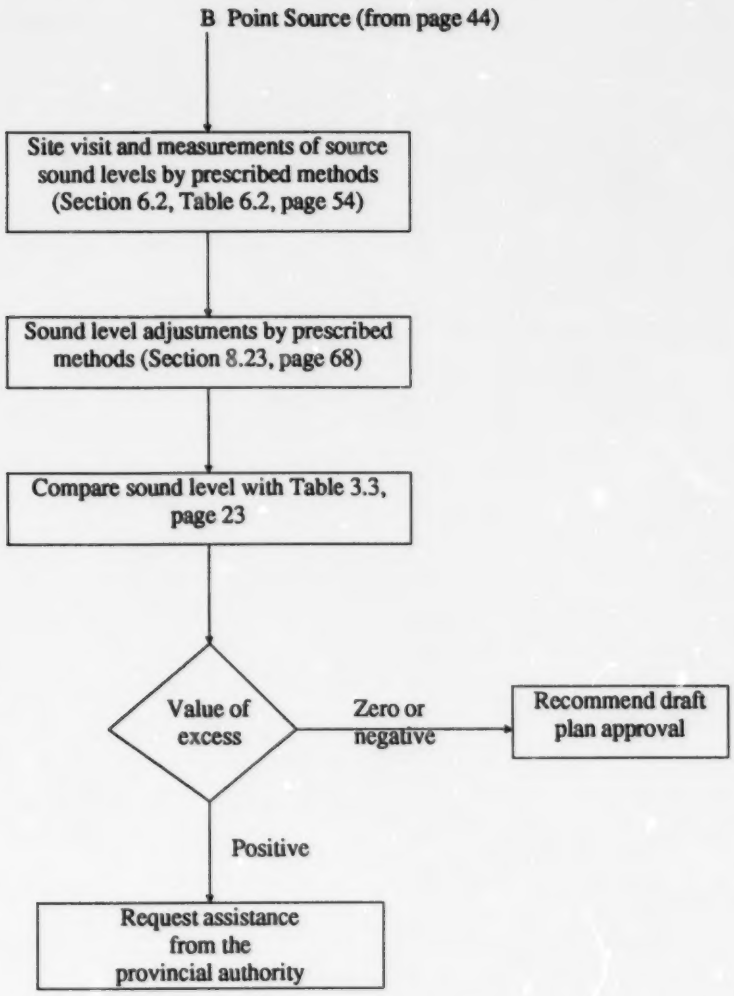
Figure 5.2 Initial Comments Procedure for Noise Impact on Proposed Residential Subdivisions

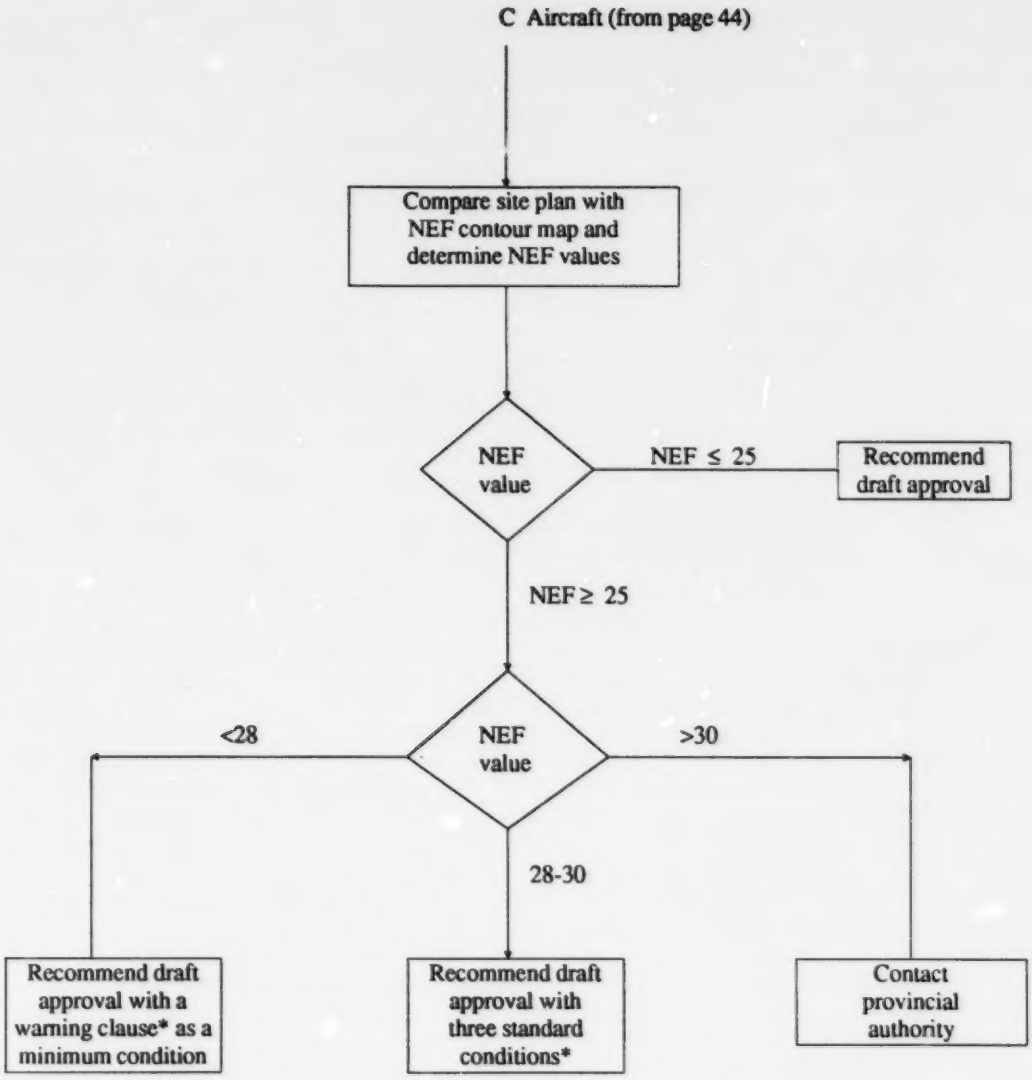

Identify all noise sources impacting on the subject land
Multiple source types
Yes
Follow procedure for single source type and combine resultant sound levels.*
No
Type of noise source
C Aircraft
(Page 47)
Point (industrial)
B (Page 46)
Determine sound levels from each source on closest lots by prediction or measurement
More than one line source impacts the site
Yes
Combine sound levels
logarithmically
Compare with land use criteria and determine excess (Table 5.2, Page 42) 55-50 L_{eq24h}
Line (road, rail)
A (page 45)

*NOTE: To arrive at a resultant sound level produced by aircraft and road/rail traffic, use the following procedure:

- Sound level from NEF value: L_{eq24h} = NEF + 31 dBA
- Combine L_{eq} values produced by aircraft and road/rail using logarithmic addition of sound levels.
- Compare the resultant sound level with Land Use Criteria (Table 5.3, page 48) 55-50 L_{eq24h}.
- Seek assistance from provincial authority.


A Line (from page 44)
Value of excess
Zero or negative
Recommend draft plan approval
Positive
Excess
1-5 dB
10 dB or more
6-10 dB
Recommend draft approval with a warning clause as a minimum condition
Recommend draft approval with three standard conditions
Recommend feasibility study be prepared prior to draft approval


B Point Source (from page 44)
Site visit and measurements of source sound levels by prescribed methods (Section 6.2, Table 6.2, page 54)
Sound level adjustments by prescribed methods (Section 8.23, page 68)
Compare sound level with Table 3.3, page 23
Value of excess
Zero or negative
Recommend draft plan approval
Positive
Request assistance from the provincial authority


C Aircraft (from page 44)
Compare site plan with NEF contour map and determine NEF values
NEF value
NEF ≤ 25
Recommend draft approval
NEF ≥ 25
NEF value
<28
>30
28-30
Recommend draft approval with a warning clause* as a minimum condition
Recommend draft approval with three standard conditions*
Contact provincial authority

*NOTE: Examples of draft plan conditions and warning clause are shown in Section 8.25, Ontario Initial Comments Procedure.

Table 5.3 Applying Recommended Sound Level Limits to Residential Land Use Developments

Excess above Recommended Sound Level Limits dBA	Change in Subjective Loudness Above	Magnitude of the Noise Problem	Noise Control Measures (or action to be taken)
No excess	--	No expected noise problem	None
1 to 5 inclusive	Noticeably louder	Slight noise problem	Optional (if no physical measures are taken then prospective purchasers or tenants should be made aware by a clause in the deed or rental agreement)
6 to 10 inclusive	Almost twice as loud	Definite noise problem	Recommended
11 to 15 inclusive	Almost three times louder	Serious noise problem	Strongly recommended
16 and over	Almost four times louder	Very serious noise problem	Strongly recommended (may be mandatory)

NOTE: When the excess is more than 5 dBA, the recommended control measures must reduce the sound level to the sound level limit and not with a 5 dBA tolerance (e.g., outdoor level during daytime must be reduced to 55 dBA and not 60 dBA).

5.1.1.4 Building and Site Plans

This step is the last opportunity for the approving authority to ensure that the agreed upon noise control measures (incorporated into the previous plans and agreements) will, in fact, be incorporated into the plans that would be used by the proponent to award contracts for construction of the project.

After considering the level of training of personnel who examine and approve building plans and the complexity of evaluating detailed noise control measures, it may be prudent for the approving agency to require that the proponent retain the services of a specialized acoustical consultant to certify building permit drawings and plans.

The acoustical consultant would be engaged by the proponent to review the plans, and provide a certificate (or stamp the drawings) to indicate the fact that all the necessary noise control measures have been incorporated into the construction documents and drawings.

The person who examines and approves the building plans then would release the drawings after receiving the consultant's verification.

5.1.1.5 Inspections

Depending on the complexity of the noise control measures and the time available to the building inspector, the approving authority may require that the proponent (in this case the builder) provide the building department with a certificate to verify the appropriateness of the noise control measures after construction or installation is complete. The development then would be released for occupancy. Some provinces require occupancy permits to be issued.

5.1.2 Controlling New Sources of Noise

Sources such as airports and railways are federal responsibilities. Federal-provincial consultation in such cases usually is encouraged to achieve an adequate degree of environmental protection.

Provincial responsibilities cover all other areas (e.g., environmental compatibility of sensitive land uses and transportation, utility and industrial facilities). Proper planning and control is required to prevent potential land use conflicts.

The procedures to deal with new potential sources of noise may be similar to those described for new receivers in Section 5.1.1. The process involves preparing initial comments, investigating and approving noise control measures at the source (as discussed in Section 7), incorporating noise control measures into plans, agreements and permit applications, and inspecting constructed noise control measures.

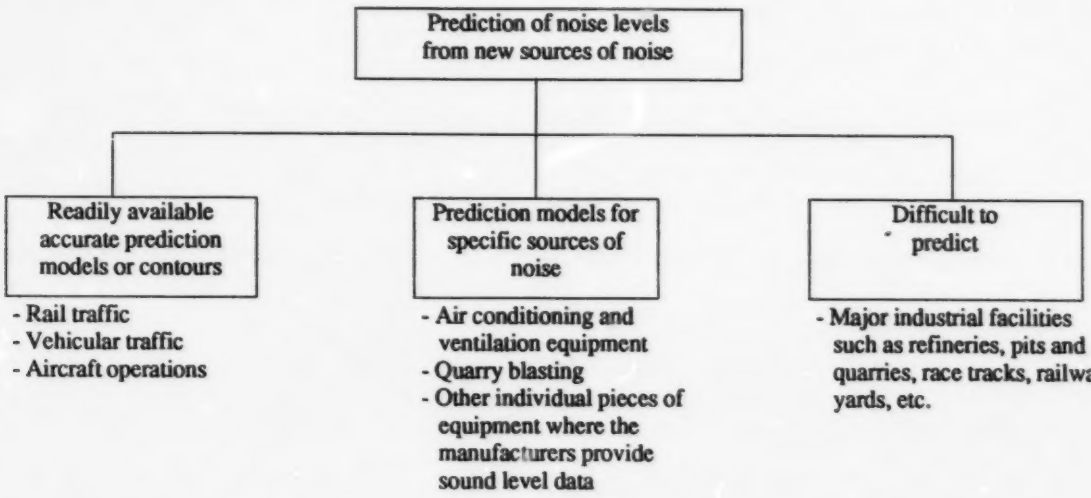
5.1.2.1 Initial Comments

When evaluating a proposed new source of noise/vibration, two problems may be encountered. The first may be the lack of information on the type and nature of the source(s) of noise to be developed (e.g., zoning a parcel of industrial land near existing residential dwellings). In many cases, the type of industry likely to build on this property would not be known.

The second problem may be the lack of simple and accurate noise prediction models on many sources of noise. The multiplicity of different types of equipment and machinery, as well as the extreme variability in the final design and installation of such sources, make it nearly impossible to provide one simple noise prediction model to enable planners and reviewers to assess the total significance of the noise source(s) impact.

Initial comments normally are prepared by the authority with the overall responsibility for approving new proposals for establishing new potential sources of noise. Table 5.4 illustrates the three primary groups of noise sources and their predictability.

Table 5.4 Primary Groups of Noise Sources and the Availability of Noise Prediction Models


Prediction of noise levels from new sources of noise
Readily available accurate prediction models or contours
- Rail traffic
- Vehicular traffic
- Aircraft operations
Prediction models for specific sources of noise
- Air conditioning and ventilation equipment
- Quarry blasting
- Other individual pieces of equipment where the manufacturers provide sound level data
Difficult to predict
- Major industrial facilities such as refineries, pits and quarries, race tracks, railway yards, etc.

Due to the complexity of predicting noise levels from new sources of noise, initial comments will have to be based on the experience of the person reviewing the proposed development. To assist in resolving this problem, it is suggested that the regulating agencies:

i) maintain an organized data bank on the noise potential of most common sources of noise;

ii) perform sound level surveys around other similar sources of noise which will give reasonable indication of the noise potential of a proposed operation;

iii) request the proponents to seek the services of specialized acoustical consultants to provide the necessary data;

iv) withhold approval of unknown noise impact situations pending the availability of the necessary noise impact data;

v) develop performance standards for new sources of noise to be included in applicable policies, regulations and standards.

In Ontario, for example, the Environmental Protection Act requires proponents of new potential sources of noise to obtain a Certificate of Approval from the Ontario Ministry of the Environment prior to constructing, altering or extending any plant, structure or equipment that may emit or discharge noise or vibration.

Proponents normally are required to submit plans, specifications and other information for review and approval by ministry staff. Many of such submissions include studies prepared by acoustical consultants.

5.1.2.2 Investigation and Approval

The need for a two-step approach to acoustical studies depends on the system adopted by each authority and the level in the planning process. The feasibility study as discussed in Section 5.1.1.2 would be suitable in cases where it is difficult to determine the type of industry that may situate on a given property. Performance standards for noise should form part of any agreement governing the approval of the proposed development.

A detailed acoustical study would be prepared in situations where the specifics of a proposed new source of noise are known better.

When dealing with planned stationary sources of noise, the authority is advised to prepare a set of guidelines for use by the proponent and consultant.

Although prediction models are available for several sources such as roadways and railways, the evaluation of the noise impact still may not be straightforward. Generally, training courses and guidelines prepared by the approving authority do not provide procedures to evaluate involved noise calculations.

An acoustical consultant should have the background and experience to solve a variety of problems including a simple development, complex situations involving interrupted barrier to stepped barrier analysis, development near a train station, bus lanes, railway yards or complex ground attenuation procedures.

Regarding measurements of sound, an acoustical consultant also should have a comprehensive knowledge of acoustic instrumentation, its applications and limitations. Field measurements may be necessary for a variety of reasons including difficult topographical features, calibration of prediction models or the presence of other sources of noise for which no prediction models are available.

For the implementation of control techniques, structural components such as fences, exterior wall specifications or window selections (for which building codes require the design services of an engineer) often would be involved. Many of the governing councils of engineering associations in Canada deem an engineer to be professionally and financially liable for the failure of any individual designs (e.g., failure of an acoustic fence to meet the required acoustical and structural performances).

Table 5.5 Sample Checklist of Requirements for Feasibility Studies - Noise Control in Land Use Planning

☐ 1. Intent of report (purpose) and relationship to the planning process (prepare appropriate conditions of draft approval).

All reports to quote the file number of the approving authority.

☐ 2. Ministry of _____ criteria for sound level limits:

(a) Indoor - L_{eq24} = 40 dBA (bedroom);
(b) Outdoor - L_{eq24h} = 55-50 dBA (outdoor living area)

☐ 3. Identify all major noise sources within 1000 feet of the proposed site and include both existing and future sources.

☐ 4. Statements concerning the prediction model(s) used.

☐ 5. Statements concerning the traffic information used, source of information, etc.

☐ 6. Noise control measures:

(a) *Indoor* - general statements of intent;
(b) *Outdoor* - general statements of intent;

and demonstration of practicability of noise control measures.

☐ 7. *Warning clause* for any residual noise problem (excess of 5 dBA or less).

☐ 8. If Steps 1 to 7 inclusive are satisfactory to _____, then we will recommend appropriate conditions for draft approval. Otherwise, reject report and recommend against giving plan draft approval until noise concerns are satisfied.

9. Copy of report to municipality (copy to _____ Office or _____), that is, the concerned municipal offices should be informed by the proponent as to their recommended noise control measures and intentions.

NOTE: Detailed calculations are not required in this study.

Table 5.6 Sample Checklist of Requirements for Detailed Acoustical Reports (Land Use Proposals Seeking Final Approval) - Noise Control in Land Use Planning

☐ 1. Intent of report (purpose) and relationship to the planning process (clear conditions of draft approval, site plan agreements, etc.).

All reports to quote the file number of the approving authority. Include both the date and a copy of the draft approved plan.

☐ 2. _____ criteria for sound level limits:

(a) Indoor - L_{eq1h} = 40 dBA (bedroom)
(b) Outdoor - L_{eq1h} = 55-50 dBA (outdoor living area).

☐ 3. Identify all major noise sources within 1000 feet of the proposed site and include both existing and future sources.

☐ 4. State prediction models (for road, rail, aircraft) used to determine noise levels. Include measurements for industrial or point-source noise. Give details of prediction techniques if different from _____ accepted procedures.

☐ 5. Supply source of *traffic* information (data must be accepted by the municipality):

(a) Traffic volumes (present and *minimum* 10 years into future (vehicles/day in summer))
(b) Truck percentage (percentage of heavy vehicles, trucks, buses, etc.)
(c) Posted speed
(d) Distance from edge of pavement to nearest outdoor living area on proposed lot
(e) - stop and go traffic)
- gradient)
- road surface) Corrections
- topography)
- multi-storey buildings.)

☐ 6. Recommended Noise Control Measures

These measures must be in accordance with the planning objectives of the municipality. Has the report identified that the consultant has discussed the recommendations with the municipality and received acceptance in principle?

(a) *Indoor Measures*

- If the noise level at the bedroom windows is 60 dBA (i.e., 10 dBA above our criteria), then central air conditioning is required. Caution about location of air-cooled condensor unit.

- If noise level is above 50 dBA and not greater than 60 dBA, then dwelling unit should have forced air heating installed with provision for central air conditioning and a cautionary note regarding provision for central air and location of unit to be added to warning clause.

- Window glazing to be specified either as pane thickness, air gap or minimum STC/AIF rating if noise level at window is 60 dBA or greater.

- Outer wall specifications to be determined and listed if outer noise level is 60 dBA or greater.

(b) Outdoor Noise Control Measures

- Acoustical barriers, berms, berm/barrier combinations

- Location, height (relative to fixed point) of the barriers

- Surface density of barrier 20 kg/m^2 (4 lb./ft^2)

- Size of outdoor living area:

  56 m^2 - detached unit
  47 m^2 - semi-detached unit
  37 m^2 - row or townhouse - per unit

- Outdoor living area shielded by dwelling unit (front or side yard privacy area, adequately screened). Easy access to outdoor living area from inside house

- Secondary barriers

- Minimum gaps between houses

- Height of dwelling unit (i.e., 1, 1 1/2, 2 storey)

- Specify noise levels in outdoor living areas after measures installed.

☐ 7. Warning Clause

To be used when noise levels are not attenuated or when the levels are reduced to within *5 dBA* of the criteria.

- Suitable wording - including additional phrase to cover provision for *central* air conditioning and location of air-cooled condensor unit

- Implementation.

☐ 8. A summary sheet of the noise control measures and conclusions so that the requirements can be easily inserted in the municipal agreements.

☐ 9. Appendix - showing sample calculations for noise levels and barrier calculations as required by NPC-134.

☐ 10. Confirmation that a copy of the acoustical report has been submitted to the municipality and, where applicable, to the approving authority such as _____ .

6. Instrument Specifications, Measurements and Prediction Models

The objective of this section is to encourage uniformity in the types of equipment and procedures utilized in the field.

This section introduces relevant information concerning: (i) instrument specifications for equipment used in measuring sound and vibration; (ii) standardized measurement methods; and (iii) identification of some currently available prediction models.

Where national standards are available, they should be specified and/or included in the reference documents of any noise control program. To achieve this end, the federal/provincial working group supports the current activities of the Canadian Standards Association in producing "Standards on Environmental Noise Measurement" and recommends the use of these standards, when published, as a part of these National Guidelines. Where national practice has not been defined, the use of internationally accepted standards should be encouraged.

For uniformity, the authority administering the noise control legislation must ensure that individuals responsible for the assessment of noise control exposure are adequately trained to perform their tasks. Training is addressed in Section 3.2.5 of this document. In all circumstances, monitoring must be conducted with care if results are to be meaningful, requiring adherence to a strict routine and a methodical approach to each situation.

6.1 Instrument Specifications

Minimum performance specifications should be adopted for equipment to be used in assessing noise and vibration. The following international standards associated with instrument specifications (e.g., International Electrotechnical Commission 651, Sound Level Meters and International Electrotechnical Commission 804, Integrating Sound Level Meters, (IE79, IE85) are suitable choices).

The types of instruments in general use are listed in Table 6.1. This table refers to the Ontario Ministry of the Environment instrument classification system. Although this system is based on Ontario experience, it incorporates accepted international practice. Greater detail of specific uses and response characteristics of each type of instrument is provided in Section 8.20.

As shown in Table 6.1, the integrating sound level meter is the most versatile instrument where only one meter will be available. In addition to its noise integrating function, it can be used as a general purpose sound level meter and normally will contain circuitry to display peak sound pressure levels or impulse sound pressure levels.

6.2 Measurement Methods

The measurement methods must be selected and used in conjunction with criteria set in the noise control legislation. The noise assessment procedures presented in this document deal primarily with receptor site measurements. These measurements can be made under three sets of conditions: prevailing, worst case or, periodically, to determine the appropriate exposure level. The decision as to the conditions which should exist at the time of measurement should be based on a consideration of the type and extent of the problem identified.

Currently, without an existing nationally recognized standard, adoption of the indicated measurement methods for varying sounds and steady or impulsive sounds is suggested. For sound and vibration from blasting, the adoption of CSA 107.54 is recommended (CS85). These recommendations are summarized in Table 6.2.

When conducting environmental noise measurements, it may be necessary to adjust the measured noise level for qualities demonstrated by the source. A discussion of the characteristics of sound and correction factors which should be applied is presented in Section 8.23.

In addition to receptor site measurements, sound level measurements can be conducted at the source of noise emissions. Procedural uniformity is paramount. Where available and applicable, Canadian Standards Association standards should be used. However, where Canadian practice has not been defined, international standards should be employed. Measurement standards have been developed for specific noise sources and should be applied as specified. Table 6.3 identifies these standard practices.

The measurement methods for noise sources and receivers provided in this section are to be used in conjunction with the criteria set out in the noise control legislation.

6.3 Prediction Models

Where sound and vibration levels have not been measured or cannot be measured, developed prediction models can assist. As the designation implies, prediction models permit sound pressure or vibration levels to be evaluated based on source descriptors and assumptions. Prediction models offer valuable assistance in the land use planning aspect associated with noise control legislation. The application is discussed in Section 5. Prediction models should be used only for the purposes intended and under the conditions specified to ensure maximum precision.

Some currently available prediction models are included in Table 6.4.

Table 6.1 Measurement Instruments and Their Application (see Section 8.20 making reference to Ontario NPC 202)

Section 8.20	Type of Instrument	Application
NPC-202.6	Integrating Sound Level Meter (incorporating general purpose and impulse or peak) (recommended first choice)	Varying Sound
NPC-202.3	General Purpose Sound Level Meter	Non-Impulsive Steady Sound
NPC-202.4	Impulse Sound Level Meter	Impulsive Sound
NPC-202.5	Peak Pressure Level Detection	Peak Pressure Perturbation (Blasting Only)
NPC-202.8	Vibration Velocity Detector	Peak Vibration Velocity in Solids (Blasting Only)
NPC-202.9	Acoustic Calibrator	Calibration of Sound Level Meter

Table 6.2 Measurement Methods for Specific Sound and Vibration Characterizations at Receptor Sites

Reference	Type of Measurement
Section 8.21	Steady or Impulsive Sound
Section 8.21	Varying Sound
CS 85	Procedure for Measurement of Sound and Vibration Due to Blasting Operations

Table 6.3 Standard Practices Associated with the Measurement of Sound Produced by Specific Sources

Designation	Title or Agency	Available From	Reference
Z107.31	Test Procedures for the Measurement of Sound Levels from Agricultural Machines	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario M9W 1R3	CS 86a
Z107.32	Test Procedure for the Measurement of Sound Emitted Forestry and Mining Machines to the Operator Station and Exterior of the Machine	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario M9W 1R3	CS 86a
Z-107.53	Procedure for Performing a Survey of Sound Due to Industrial, Institutional or Commercial Activities Sources	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario M9W 1R3	CS 82
Z-107.54	Procedure for Measurement of Sound and Vibration Due to Blasting Operations	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario M9W 1R3	CS 85
SAE J88a	Exterior Sound Level Measurement Procedure for Powered Mobile Construction Equipment, Society of Automotive Engineers Inc., Warrendale, Pa. 15096	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario M9W 1R3	SA 75
SAE J1046 a	Exterior Sound Level Measurement Procedures for Small Engine Powered Equipment, Society of Automotive Engineers Inc., Warrendale, Pa. 15096	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario M9W 1R3	SA 76
SAE J88EP80	Sound Measurement-Earth Moving Machinery-Exterior, Society of Automotive Engineers Inc., Warrendale, Pa. 15096	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario M9W 1R3	SA 80
ANSI 5.1 (1971)	CAGI-PNEUROP Test Code for the Measurement of Sound from Pneumatic Equipment, First Edition Compressed Air and Gas Institute, New York, N.Y. 10017	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario M9W 1R3	CA 69
Fe 75	Noise Emission Tests Motor Vehicles	Canada Transport-Road Motor Vehicle Safety and Regulations Place de Ville, Tower A, 16th Floor Ottawa, Ontario K1A 0N5	Motor Vehicle Safety Act, Motor Vehicle Safety Registration, Federal Government
SAE J986 a	Sound Level for Passenger Cars and Light Trucks, Society of Automotive Engineers Inc., Warrendale, Pa. 15096	Canada Transport-Road Motor Vehicle Safety and Regulations Place de Ville, Tower A, 16th Floor Ottawa, Ontario K1A 0N5	Motor Vehicle Safety Act, Motor Vehicle Safety Registration, Federal Government
	Uniform Provisions Concerning the Approval of Vehicles with Regard to Noise	Canada Transport-Road Motor Vehicle Safety and Regulations Place de Ville, Tower A, 16th Floor Ottawa, Ontario K1A 0N5	Motor Vehicle Safety Act, Motor Vehicle Safety Registration, Federal Government

Table 6.4 Prediction Models for Sound and Vibration

Use	Document Title and Agency	Reference No.	Available From
Airport Noise	N.E.F. Contours Relating to Airport Noise, Transport Canada, Ottawa (a series of maps with noise contours)		CMHC Offices Transport Canada (Regional Offices)
Airport Noise	N.E.F. System Users Manual TP6012E (R-84-11) Transport Canada Ottawa, Ontario		Transport Canada (Ottawa, K1A 0N8 (613) 991-9974)
Airport Noise	Land Use in the Vicinity of Airports, 6th Edition, November 1985 TP1247E or TP1247F Transport Canada Ottawa, Ontario	TR 85	Transport Canada Aeronautical Information Publications (Ottawa, K1A 0N8 (613) 991-9950)
Airport Noise	New Housing and Airport Noise Canada Mortgage and Housing Corporation, Ottawa, 1981	CM 81b	CMHC Offices
Road and Rail Noise	Road and Rail Noise: Effects on Housing Canada Mortgage and Housing Corporation Ottawa, 1981	CM 81a	CMHC Offices
Road Noise	Guidelines for Road Traffic Noise Assessment	ON 86b	Ontario Ministry of the Environment Operational Services Environmental Approvals and Land Use Planning Branch 135 St. Clair Avenue West Toronto, Ontario M4V 1P5
Blasting	U.S. Bureau of Mines		
Fan Noise	Chapter 32, Sound and Vibration ASHRAE Systems Handbook	AS xx	American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. 345 East 47th Street New York, N.Y. 10017
Industrial Plants	Recommended Practice for the Prediction of Sound Levels Received at a Distance from an Industrial Plant, Z107.55 Canada Standards Association Rexdale, Ontario (computer model available)	CS 83	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario M9W 1R3
Unitary Equipment	ARI 275-1984, Standard for Application of Sound Rated Outdoor Unitary Equipment ARI 270-1984, Standard for Sound Rating of Outdoor Unitary Equipment		

7. Noise Reduction Techniques

Noise from almost any source can be controlled. Trial and error is rarely necessary as noise control is a well-established discipline, with many tested solutions available. It is strongly recommended that anyone planning or instituting noise control obtain expert help to establish the available alternatives, costs and expected results. Acoustical consultants are listed in the yellow pages of directories for most Canadian cities. A list is also available from the Canadian Acoustical Association, P.O. Box 1351, Station F, Toronto, Ontario M4Y 2V9.

This section will provide an overview of the techniques commonly used to control noise in the community. It is intended to familiarize noise control officers with the techniques applied by professionals in noise control. Neither noise control officers nor other untrained people should try to apply these techniques without professional assistance.

The intent of this section is to make the reader aware of the technology which is commonly used to control noise. There are many books on the topic for those who wish to read further.

Noise control measures can be applied to reduce noise at the source (car mufflers), at the receiver (special windows) and on the path between source and receiver (highway noise barriers). Each of these approaches is discussed with examples from commonly encountered community noise sources.

7.1 Noise Reduction at the Source

The methods of noise control used most commonly to control noise sources encountered in the community are discussed briefly in the following sections:

7.1.1 Buying Quiet Equipment

Generally, the most cost-effective noise control methods are those that can be designed into new facilities rather than those retrofitted to an existing operation.

Consequently, it is far less expensive to buy quiet equipment than to silence noisy equipment. Most manufacturers can provide sound level data for their equipment. If requested, they often can provide quiet models.

To specify sound levels for equipment, it is necessary to predict the sound level from the equipment at the nearest noise sensitive location, usually the nearest residence. There are many different prediction methods which can be applied by those trained in acoustics.

A conservative approach to predict the sound level Lp(r) for single compact sources is to subtract 6 dBA for each doubling of distance. This approach can be used only in situations where the manufacturer gives a sound level Lp(d) measured at a standard distance, d, greater than-major equipment dimensions.

For other distances this measurement is equivalent to the following formula, which can be solved easily using a calculator with the log (base 10) function:

$$Lp(r) = Lp(d) - 20 \log (r/d)$$

where r is the distance from source to receiver
Lp(r) is the sound level at distance r
d is a standard measurement distance and
Lp(d) is the sound level at distance d.

Example:
A front-end loader produces 85 dBA at 15 m, according to the manufacturer's measurements.
It would produce 85-6 = 79 dBA at 30 m (doubling the distance)
At 100 m it would produce:
85 - 20 log (100/15) = 69 dBA

If the desired sound level was 65 dBA at 100 m, a new unit would be specified to obtain 81 dBA at 15 m, or other measures would have to be introduced.

7.1.2 Equipment Modification

Source modification can involve retrofitting noise control measures to existing equipment. An important first step is consultation with the equipment manufacturer to determine whether noise reduction kits are available for the equipment.

In some cases, modifications to the equipment may reduce sound levels. These changes may include slowing down motors, cushioning impacting parts and installing silencers.

7.1.2.1 Silencers

Mufflers (reactive silencers) are used to control low frequency noise propagating in ducts by means of wave cancellation within the muffler. The most common example is a car muffler. Noise reductions of 10-20 dBA commonly are achieved with mufflers. At this point, other sources associated with the same machine usually limit the overall noise reduction.

Silencers (absorptive silencers) are used to control mid-to high-frequency noise in ducts and openings by lining the walls with sound-absorbing material over which the sound must pass. In some cases, a duct will be split into a series of smaller ducts to increase the silencing per unit length. Fan silencers are the

most common example, and are found in most commercial ventilation systems. Noise reductions of 10-20 dBA commonly are achieved.

Blow-off silencers are available to control the noise of escaping steam or compressed air. They often can give in excess of 20 dBA attenuation.

7.1.3 Enclosures and Lagging

A common abatement technique is to enclose a noise source. A typical home-made design might be one-half inch plywood, or other heavy material. It should be lined with two inches of fiberglass or mineral wool insulation covered with wire mesh to keep it in place but allow the sound to penetrate.

In some cases, a sound-producing surface, like a large pipe or duct, may be lagged. This procedure is achieved using a heavy limp material, such as lead-loaded vinyl or lead separated from the surface by resilient insulation.

For both enclosures and lagging, there are two concerns - heat build-up and maintenance access. The former may be solved by ventilation, with the air passing in and out through silencers. The latter requires careful design of doors and removable panels.

Any opening left in an enclosure or rigid attachment between the noise source and the outer casing can seriously degrade the acoustical performance of an enclosure, no matter how well the rest may be constructed. Where possible, openings should be minimized or treated with silencers, baffles or curtains. Direct contact with the noise source often can be eliminated by installing a resilient pad or gasket at the point of contact.

A noise reduction of 10-15 dBA is typical, although a well-designed enclosure occasionally can be an improvement.

7.1.4 Operational Modifications

An alternative to add-on noise control is operational modification. This modification includes restrictions on the use of equipment to specific time periods or locations.

7.1.5 Orientation and Relocation

When a new facility is designed, there may be an opportunity to allow noise sources to be located away from sensitive areas. In some cases, buildings also may be oriented to act as barriers. Predicting the noise impact of any new installation is feasible and practical.

In designing any new facility, it is good practice to have someone knowledgeable in acoustics and noise control examine the design and work with the engineers, planners and architects to ensure that noise problems are handled before they develop.

7.2 Pathway Modification

The transmission path encompasses the area between the source and receiver over which the noise travels. Control measures can be applied between the source and receiver which affect the propagation of the noise without modifying the source or perceptively affecting the receiver.

Transmission path modifications are usually less effective than source modifications but, in some cases, they can be the most appropriate alternative.

7.2.1 Land Use and Site Planning

Section 5 of this document outlines land use and site planning in relation to sources and receivers. Appropriate application of land use planning can offer an opportunity to effectively minimize receiver exposure to environmental noise.

7.2.2 Barriers

Well-designed barriers can be effective in reducing sound levels. However, other site-planning measures also should be considered before a decision is made on their use.

For a barrier to be effective, it should be high enough to intercept the line of sight from the source to the receiver. The reduction achieved is dependent on the difference in the path length which sound must travel with and without the barrier (i.e., the difference between a straight line path without a barrier, and the bent path over the top of the barrier).

Highway noise barriers typically provide 5-10 dBA noise reduction for the first row of houses behind them and have little effect further back in the community.

Barriers should be long enough so that sound cannot pass easily around the ends. This situation is achieved most easily when the barrier is close to either the source or receiver. The barrier itself must be solid, free from gaps or holes and have adequate mass.

Safety must be considered also in selecting a barrier design, while structural stability and durability of the berm, servicing, maintenance and erection costs are other important considerations. Currently, the CSA is preparing a standard giving specifications for materials and installation of barriers.

Barriers may take the form of green belts, topographical features, earth berms and intervening structures, as well as conventional free-standing noise barriers. Each is discussed below.

7.2.2.1 Green Belts

A barrier can be provided, in some cases, by a green belt of tall, dense trees and thick underbrush. Provided that a continuous barrier is formed, they can be effective in reducing sound levels by approximately 5 dBA per 100 feet of green belt (ON 86b).

The effectiveness of a tree stand depends on the density, height and depth of the trees and the leaf size. Trees and shrubs are pleasant to look at, which is just as important as their noise reduction capability.

7.2.2.2 Topography

Existing topographical features such as valleys or ravines can often be exploited successfully to act as natural barriers. They are aesthetically more desirable than man-made walls. In some cases, topographical features can be enhanced or created at the site by excavating or landfilling, or by lowering a road level. Generally, costs tend to be lower than for the erection of berms or walls.

7.2.2.3 Earth Berms

An earth berm is a mound of earth running parallel to the noise source or a row of residences. The sloping side deflects sound upwards and away from the source. The berm's surface also tends to absorb sound. Both these factors cause lower sound levels on the source side compared to the levels achieved by a wall. Berms can range up to 15 feet or more in height and still be satisfactory from an aesthetic viewpoint.

Usually the width of a berm must be six times the height. Thus, provisions must be made in the early planning stages to allow for more land. The resulting higher costs can be offset, to some extent, by using the slopes for recreational purposes.

Erection of berms is more economical if surplus earth is available from excavations or site grading. The cost of building a berm should take into account erection costs, the expense of cutting the grass and snow removal. Structural stability and durability are also major considerations.

7.2.2.4 Free-Standing Noise Barriers

Free-standing noise barriers require a minimum of space, allow easy maintenance and provide physical separation of a receiver from the noise source. They can supplement the height of a berm which cannot be built higher because of structural or space considerations. They also can be used to shield a receiver where insufficient land is available to erect a berm.

Concrete noise barriers are most common, followed by brick, timber and sheet metal. Structural and stability considerations are especially critical in designing high noise barrier walls (higher than 3 m (10 feet)).

There have been cases where poor design has forced early replacement of noise barriers, resulting in a major expense for the home owner on whose property it sits. The new CSA standard being developed is intended to ensure that noise barriers have a 20-year lifetime as a minimum.

Noise barriers reduce dust, dirt and litter in the yard and home, reduce headlight glare, and provide visual shielding. Disadvantages include cost, maintenance, snow removal problems, and the unpleasing appearance of long, high shields.

7.2.2.5 Intervening Structures

Buildings located in the first row of a subdivision can perform the function of a noise barrier for the rest of the site. These buildings are called barrier blocks, and may be used to shield outdoor recreational areas and other structures.

7.3 Noise Control at the Receiver

In some situations, there is no economically feasible way to prevent noise from reaching a residential building. Although outside sound levels may be high, it is always possible to design the structure to achieve suitably quiet conditions inside.

7.3.1 Residential Subdivision Design

Section 5 discusses subdivision site planning in detail for provinces where planning is highly developed. For provinces which do not handle planning in such a formal manner, it is advisable to evaluate the potential for noise impact, and apply noise control measures wherever a subdivision is planned near a potential noise source (e.g., subdivisions adjacent to a busy road, a rail line, an airport or an industrial installation).

Each site is unique in its requirements and potential solutions. To judiciously apply the various techniques available to control noise, the services of an individual with acoustical expertise should be used.

The development initially should be reviewed relative to the overall site planning including source location, buffer zones and receiver orientation. Topography and existing or proposed berms, walls and buildings which may act as barriers should be considered.

Once the site considerations have been determined and the potential noise environment identified, the building design and construction considerations can be addressed as outlined in Sections 7.3.2 and 7.3.3.

7.3.2 Architectural Design

The sound levels at the receiver can be reduced by designing the layout of a building, especially the positions of walls and windows, to reduce sound levels. The following are some options available:

7.3.2.1 Blank Walls

This option is used mainly for dwellings exposed to very high sound levels where even a very good window would allow too much sound to enter. Resulting poor lighting and ventilation dictate that this measure be used with the utmost discretion and only as a last resort.

7.3.2.2 Interior Layout

Indoor sound levels in noise-sensitive areas of the home can be lowered by arranging less sensitive rooms and spaces adjacent to the noise-exposed walls. Noise-sensitive areas are considered to be the bedrooms, living room and den. Less noise-sensitive areas are the kitchen and bathroom, and such areas as closets, storage rooms, corridors and stairways.

7.3.2.3 Balconies

Balconies and terraces should be located on the shielded side of a building.

7.3.3 Construction Techniques

Sound levels inside buildings can be reduced further by using special construction materials and techniques to reduce sound level from highways. The two main options are:

7.3.3.1 Special Acoustical Treatment

Noise-insulating walls use double-layer construction with wider air spaces and thicker insulation material. Careful caulking of all potential openings is essential.

Decreasing the noise entering through windows can be achieved by sealing standard windows into the wall and reducing the size of windows. Special windows with thick glass, good sealing and double glazing with large air spaces between panes may be used also.

Doors are also weak points in a structure. Improving their performance may involve using solid core doors, adding a screen door or providing double doors or vestibules.

Special acoustical treatment of roofs generally is needed only for buildings exposed to aircraft flyover noise.

7.3.3.2 Air Conditioning and Ventilation

Noise abatement methods such as blank walls or sealed windows may require installing air conditioning, which can result in high energy use and, therefore, high costs. Alternate ventilation systems are available which bring in outside air through silencers. These systems, however, are not in wide use because the appeal of air conditioning to purchasers usually more than offsets the difference in cost.

7.4 Noise Control Measures for Common Community Noise Sources

The following subsections discuss common noise sources in the community, and how the methods outlined above are used for control. Familiarity with these approaches should assist in evaluating specific situations.

7.4.1 Transportation Noise

Transportation noise is the most common and pervasive noise in the community. It is a noise source over which individuals have little control. However, federal and provincial laws and policies, and consumer pressure have resulted in design changes and mitigating measures providing considerable noise reduction in some cases.

7.4.1.1 Road Vehicles

The most common source of noise in the community is road traffic - cars and trucks contribute almost equally. Considerable effort is expended in controlling noise from passenger cars. Although these measures are directed primarily at passenger comfort, attention also is paid to noise emissions. Presently, the major source of noise in cars is tire noise, which has been reduced to be slightly louder than smooth rubber tires.

Research is continuing on developing quieter tires and pavements. The Ontario Ministry of Transportation and Communications developed a hot strip asphalt coating to be applied over worn concrete pavement which is considerably quieter than alternative refinishing methods.

Truck noise is dominated by tire noise at high speed and engine noise at lower speeds. New trucks must meet federal standards on noise emissions, currently 83 dBA at 15 m under full throttle.

Motorcycles, straight from the factory, are reasonably quiet. Proper operation does not generate serious noise impact. Inconsiderate use by a minority has tended to give motorcycles a reputation as noisy vehicles.

Sometimes motorcycles are modified by removing or gutting the muffler to improve their performance, which is a counter-productive manoeuvre. A well-designed motorcycle muffler actually may improve the performance of the engine by using tuned resonators in the muffler.

Education and enforcement of existing regulations concerning mufflers are the main methods of control available.

Often barriers are the only feasible method of reducing sound levels from highways, which are discussed in Section 7.2.2.

7.4.1.2 Rail Vehicles

Noise from rail vehicles is generated by the engine, the wheels on the rails and whistle. The latter can be controlled only by providing alternate safety measures such as crossing barriers.

Wheel rail noise can be kept to a minimum by proper maintenance and grinding of wheels and rails, and by using continuous welded rail instead of jointed rail.

Engine noise is made up primarily of exhaust noise and noise from cooling fans. Both these can be controlled with mufflers, however space constraints limit the size and, consequently, the effectiveness of mufflers. Most Canadian locomotives meet American limits of 96 dBA at 30 m under full throttle to allow them to operate in the United States.

7.4.1.3 Aircraft

Jet aircraft are probably the noisiest single sources of noise in the environment, and undoubtedly cause major concern around airports and under flight paths leading to runways. Regulation in the United States has forced the aircraft industry around the world to produce quieter engines and aircraft for civil aviation.

Restricted flight corridors, controls on development around airports and special construction for buildings are the available options to control aircraft noise.

7.4.2 Outdoor Sources

Although this section cannot discuss every outdoor noise source, some of the more common ones are listed as follows:

7.4.2.1 Buildings

Noise emitted from industrial, commercial or residential buildings is much less widespread than transportation noise and affects fewer people, but it can be a serious concern for nearby residents.

In most circumstances, buildings in Canada are constructed sufficiently well that little sound of concern comes out through the wall or roof. A better than normal wall construction is necessary only in extreme cases.

Doors, windows and other openings are often weak links in the building envelope, especially if left open in warm weather. Treatment may involve forced mechanical ventilation and construction of vestibules.

Ventilation openings are common sources of escaping noise in industrial buildings. These openings can be equipped with acoustic louvres or silencers which reduce sound levels by about 10 dBA. However, the size of the openings must be increased significantly to provide sufficient air.

7.4.2.2 Fans

Fans are the most common stationary noise source, are found almost everywhere and, by their nature, create noise. The control of noise from fans and other air-handling equipment is routine.

Most fan manufacturers can provide good information on sound levels from their fans and ways to silence them. Various prediction methods also exist for predicting sound levels from various types of fans.

The Air Moving and Conditioning Association (AMCA) has published standardized laboratory procedures for measuring fan noise, which can be used as a basis for specifying new fans.

Fan noise commonly is controlled with silencers or sections of ductwork lined with sound-absorbing material (e.g., fiberglass or mineral wool). Allowance must be made for the extra pressure drop of the silencer in specifying the fan. The design of an acoustically acceptable fan silencer combination is always possible. However, acceptable noise reduction does not necessarily result from retrofitting an existing fan with a silencer of adequate acoustical performance. Reducing fan speed can be very cost-effective where possible.

7.4.2.3 Air Conditioners

Air conditioners are a common source of noise complaints (e.g., window units, central air conditioners and units for industrial and commercial buildings).

In most situations, the main reason for complaints is poor location of the unit. The installer/contractor should ensure that the unit is suitable for the location. Usually, a site near the house in the front yard is most suitable for central residential units, since traffic masks the sound of the unit.

The Air Conditioning and Refrigeration Institute (ARI) has procedures available to allow prediction of sound levels. The requirements in Section 8.4 can be used to evaluate these predicted levels.

For an existing air conditioner, there are four options to reduce sound levels: relocation, slowing the fan, barriers and enclosures.

Relocating the unit is easy with window units but naturally affects which rooms are cooled. Central air conditioners are more expensive to move because new lines filled with freon are required, and the work must be done by an air conditioning contractor.

In some cases, it is possible to slow down the fan of central units and reduce noise. This adjustment should be attempted only after checking with the manufacturer or an air conditioning contractor.

Depending on the configuration of the unit and the areas sensitive to the sound, a solid wall may provide sufficient attenuation, up to 10 dBA if it causes the sound to make a substantial detour.

Enclosing an air conditioner can be difficult for two reasons:

1. The fans are sized very near their limits, and consequently the air flow must not be impeded. At the same time, it is necessary to provide silencing by having the air pass through a section of duct.
2. There is a tendency to recirculate heated air within the enclosure unless care is taken to separate the fan inlet and outlet physically.

The duct should be straight and have an open area at least as large as the air grille on the unit. The length should be greater than twice the width and the duct should be lined with sound-absorbing material, such as two inches of fibreglass insulation. All designs should be checked with the manufacturer before installation.

Some designs of enclosures have been prepared by the National Research Council (NRC) (Canadian Acoustics, Vol. 13, No. 3) as test cases. However, NRC will not take responsibility for their application in particular cases.

7.4.2.4 Stacks

Sound sources which are high in the air (e.g., stacks) allow sound to propagate directly to neighbouring properties without the attenuation from the ground, and from intervening buildings commonly found for lower sound sources.

Sometimes silencers can be retrofitted into existing stacks by lowering splitters into the stack, which can be expensive because of the crane or helicopter required. In a new installation, silencers fitted between the fans and the stack may be used.

7.4.2.5 Cooling Towers

Cooling towers are difficult to silence because of large-diameter fans. However, manufacturers usually have good information on the amount of noise various sizes produce, which allows the proper size to be purchased and located to reduce noise. The large-diameter fans are usually reasonably quiet.

7.4.2.6 Compressors

Compressors usually are located indoors but their air intakes, which can be noisy, often are taken from outside.

Silencers for air intakes of compressors, including rotary lobe blowers, are available from many silencer manufacturers, and usually can be retrofitted to existing installations.

Compressor manufacturers now offer quiet packages for new installations, which are effective for sound levels close to the equipment. For environmental noise, the intake muffler is the most important item, since it is specified in terms of its pressure drop for a given flow and insertion loss in octave bands. Acoustical training is required to prepare such a specification.

7.4.2.7 Yard Equipment

Mobile equipment operating outside the confines of a plant building (e.g., forklifts, front-end loaders and trucks) can disturb the neighbours of an industrial plant.

Noise from mobile equipment can be controlled by adding a better muffler and enclosing the engine. Usually, suggestions to control noise are available from the manufacturer.

Careful siting of buildings and other areas to separate these activities from sensitive neighbours is the best approach in many instances.

CSA Standard Z107.32, Test Procedure for the Measurement of Sound Emitted from Construction, Forestry and Mining Machines to the Operator Station and Exterior of the Machine, can be useful in specifying sound levels for this equipment. For example, new trucks generally produce between 78 and 82 dBA at 15 m under full throttle. Other mobile equipment may produce similar or slightly louder noise.

7.4.2.8 Transformers

Transformers hum at 120 Hz and its harmonics (multiples). In addition, larger transformers also have cooling fans which can be more serious sources of noise.

Silencing the cooling fans and enclosing transformers, either by a wall or in a building, are the most common methods of control.

The National Electrical Manufacturers Association (NEMA) publishes sound level ratings for various types of transformers. If these ratings are not sufficient for a particular situation, the manufacturer can be contacted.

7.4.2.9 Construction

Construction is usually of reasonably short duration and, therefore, often is allowed some latitude in the sound levels produced, compared to the sound levels allowed for a fixed installation. Section 8 gives reasonable performance levels for equipment.

7.4.2.10 Quarries

Quarries may operate for many years in quiet rural areas. Quieter equipment, good mufflers and maintenance, construction of berms and considerate scheduling of noisy operations are the usual approaches to control quarry noise. Because berms can be constructed higher than highway noise barriers and the pit usually depressed, the performance of berms can be much better than highway noise barriers.

Blasting noise controlled to meet the guidelines in NPC 119 should not cause structural damage, although it still will be very obvious to nearby residents. Reducing the charge per delay (i.e., replacing one big bang with a lot of little ones) is the normal method of reducing the noise and vibration from a blast. Usually, it is not practical to reduce noise to the point where it is not disturbing.

Scheduling blasts at an expected time, whistle signals and other ways of warning neighbours can reduce the startling effect of the blast.

8. Technical Support Documents

Introduction

This section contains abstracts of technical support documents from Alberta, Manitoba, Ontario and Quebec that are included in their entirety among the microfiches attached to the Guidelines.

The abstracts are intended to assist the reader in evaluating the content of the particular technical document that will be selected and included in the document of a proposed noise control program.

The complete documents are available from the province of origin.

8.1 MOE Publication NPC-105 Stationary Sources

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law drafted by the Ministry for adoption by the local municipalities in Ontario. Publication NPC-105 sets out the sound level limits for stationary noise sources, using the road traffic noise background as the standard allowable sound level for a stationary noise source. The levels would be measured using one hour equivalent energy sound level (Leq) in decibels (dBA).

For various impulsive sources specific limits are set depending on the type of the particular source in A-weighted impulse sound level (dBAI).

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.2 MOE Guidelines for Road Traffic Noise Assessment

This document contains the latest generally used guidelines published by the Ontario Ministry of the Environment to evaluate the sound level of road traffic. The guideline is a short form of the United States Federal Highway Administration Road Traffic Noise Evaluation Methodology. The document itself provides a manual calculation method with helpful tables. The Noise Assessment Unit of the Ministry of the Environment also makes available on request a program called STAMSON on floppy diskette for personal computers which will do calculations in a very user friendly manner. The methodology is a short form of a computer program of the Ministry of Transportation and Communications in Ontario created to assist in the design of freeways in Ontario.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.3 MOE Publication NPC-115 Construction Equipment

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law drafted by the Ministry for adoption by the local municipalities in Ontario. It is also a guideline to be used by the Ministry to evaluate environmental assessments under the Environmental Assessment Act, and various applications for Certificates of Approval under the Environmental Protection Act. This publication sets out sound emission standards for various items of new construction equipment according to the date of manufacture. It includes limitations for excavation equipment, dozers, loaders, backhoes, pneumatic pavement breakers, portable air compressors and tract drills.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.4 MOE Publication NPC-116 Residential Air Conditioners

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law

drafted by the Ministry for adoption by the local municipalities in Ontario. Publication NPC-116 sets out the sound level limits for residential air conditioning devices, including central and through-the-wall air conditioning units and heat pumps. This publication also serves as a guideline for abatement and approval purposes by the Ministry of the Environment.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.5 MOE Publication NPC-117 Domestic Outdoor Power Tools

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law drafted by the Ministry for adoption by the local municipalities in Ontario. Publication NPC-117 sets sound emission standards for walk-behind powered lawnmowers.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.6 MOE Publication NPC-118 Motorized Conveyances

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law drafted by the Ministry for adoption by the local municipalities in Ontario. Publication NPC-118 sets sound emission standards for heavy vehicles with governed diesel engines. The sound level limitation depends on the date of manufacture.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.7 MOE Publication NPC-212 Blasting (Draft)

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law drafted by the Ministry for adoption by local municipalities in Ontario. Publication NPC-212 is a draft revision of an earlier publication, NPC-119, and refers to limits of sound (concussion) and vibration due to blasting operations, usually carried out in quarries. The sound (concussion) is identified by measuring the peak pressure level. The vibration is identified by measuring the velocity of ground vibration.

This publication contains sections on instrumentation, measurement of sound and vibration, and limits applied to sound (concussion) and ground vibration velocity.

This publication is used by the Ministry for the assessment, abatement and approval purposes to evaluate the effect of blasting on people and structures.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.8 MOE Publication NPC-131 Guidelines for Noise Control in Land Use Planning

This publication of the Ontario Ministry of the Environment was drafted for the assessment of proposed residential land developments. Publication NPC-131 refers to the noise environment on the site of proposed residential or other sound sensitive development in an urban area. Specified sound level limits apply to new developments as well as alteration to or conversion of any existing development or construction. The guideline defines various terminologies such as outdoor recreational area, control measure and architectural design and construction. It also sets out indoor and outdoor sound level limits in terms of equivalent sound levels (Leq) in dBA for applicable time periods.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.9 MOE Publication NPC-132 Guidelines for Noise Control in Rural Areas

This publication of the Ontario Ministry of the Environment suggests sound level limits for stationary sources in rural areas where the acoustical environment normally is dominated by natural sounds and where road traffic, if any, is not frequent. Publication NPC-132 sets out sound levels in terms of equivalent sound levels (L_{eq1h}) and 90 percentile sound level (L_{90}) for one-hour duration. Suggested limits are given for general and impulsive noise sources.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.10 MOE Publication NPC-133 Guidelines on Information Required for the Assessment of Planned Stationary Sources of Sound

This publication of the Ontario Ministry of the Environment refers to information required for the assessment of planned stationary sources of sound, in compliance with Section 8 of the Environmental Protection Act or for the purposes of the Environmental Assessment Act. The guidelines apply to new sources of sound as well as expansion, alteration or conversion of existing sources. The publication includes measurement standards and procedures as well as sound level limits for urban and rural areas. The publication also sets out quite specific and detailed lists of required information, the assessment of potential noise impact for large installations, approval of the abatement program, and report format.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.11 MOE Publication NPC-134 Guidelines on Information Required for the Assessment of Planned New Land Uses with Respect to Sound and Vibration Impacts

This publication of the Ontario Ministry of the Environment refers to information required for the assessment of planned new land uses with respect to sound and vibration impacts, in compliance with provisions of the Planning Act, the Environmental Assessment Act and other relevant Ontario legislation. Guidelines are contained in the document that apply to changes of official plans, rezoning, applications for subdivision approval, and all new land uses adjacent to major transportation and energy corridors, industries and airports. The document provides measurement standards and procedures, and lists required information in terms of existing and potential sound sources, the acoustic environment at the site, and the preparation of impact statement. The document also provides description of report format preferred for the purposes of evaluation.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.12 MOE Publication NPC-135 Certificate

This publication of the Ontario Ministry of the Environment sets out the minimum requirements for granting a certificate of competency in environmental acoustics technology. The purpose of the publication is to provide a description of the requirements for those wishing to take the certificate course. Certifications may be obtained for qualifying to become a municipal noise control officer or a person qualified to do the assessment of noise in the area of land use planning. The Ministry conducts certificate courses and provides manuals based on the guidelines available from the Model Municipal Noise Control By-Law as well as other documents prepared by the Ontario Ministry of the Environment and other organizations.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.13 Ontario Land Use Policy near Airports

The Ministry of Housing issued a policy statement in March 1978 based on the NEF (Noise Exposure Forecast) system to protect lands near airports from the discomfort caused by aircraft noise. The four-page document describes land use compatibility in terms of the NEF numbers, and adopts acoustic design criteria for residential and non-residential construction using available Canada Mortgage and Housing Corporation (CMHC) guidelines. It also refers to NEF contour maps available from the federal government pertaining to various international and municipal airports in Ontario.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.14 Ontario Guidelines for Railway Traffic Noise Assessment (Draft)

This document is an instrument manual that contains the MOE's recommended train traffic noise prediction procedure used in land use planning. Specifically, it presents the calculation procedure that yields the energy equivalent sound level, L_{eq1h}, at a point of reception.

The prediction method is based on a model contained in the Canada Mortgage and Housing Corporation (CMHC) manual *Road and Rail Noise: Effect on Housing, 1981*. The adjustments to the reference level for distance and shielding are defined identically to those contained in the MOE publication *Guidelines for Road Traffic Noise Assessment, July 1986*.

The first part of this manual describes the prediction procedure and the second part contains a set of appendices to assist in the calculations.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.15 Ontario Final Report of the Interministerial Committee on Pits and Quarries

The final report of the Interministerial Committee on Pits and Quarries contains a 13-point agreement representing a strategy to deal with the environmental aspect of pits and quarries at the various stages of the planning and approvals processing. It is based on available approval mechanisms under the Environmental Protection Act and in the proposed Aggregates Act. The report was issued in September 1983 based on the cooperation of the ministries of Natural Resources, Environment, and Municipal Affairs and Housing of Ontario.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.16 Quebec Hot Mix Asphalt Plants Regulation

There is reference to noise in Sections 9, 10, 11 and Section B of this regulation (C. 2.2, 4.25, 1981) under the Province of Quebec Environmental Quality Act (RSQ, c. Q-2, s. 31).

Section 9 specifies the minimum distance (150 m) between a hot mix asphalt plant and dwellings, schools, places of worship and campgrounds.

Section 10 specifies the exception to Section 9 if the noise level is 40 dBA or less between 18:00 and 06:00, and 45 dBA between 06:00 and 18:00 at the boundary of the residential (or other) zone.

Section 11 refers to the noise measurement method in Schedule B.

In this measurement method, the hot mix asphalt plant is considered to include the loading, unloading and discharge areas of aggregate material.

Contact:

Mr. Jean-Pierre Létourneau
Noise Pollution Control Engineer
Direction de l'assainissement de l'air
Ministère de l'Environnement
2360, chemin Ste-Foy
Ste-Foy, Québec
G1V 4H2
(418) 643-5559

8.17 Quebec Regulation Respecting Pits and Quarries

Reference to noise is made in Sections 11, 12, 13 and Schedules D and E of this regulation (2-2, r-2, 1977), under the Province of Quebec Environmental Quality Act (RSQ, C. 2-2, ss. 20, 22, 23, 31, 46, 70 and 87).

Acoustics definitions in Section 1 include importunate frequency band, impact noise, information bearing noise, dB.

Section 11 specifies the minimum distance (600 m) allowed between a new quarry and dwellings, and the minimum distance allowed between new pits (150 m) and dwellings.

These minimum distances also apply to schools, places of worship and campgrounds.

Section 12 specifies exceptions for noise. These exceptions apply where the noise measured at the boundary of the residential (or other) zone does not exceed 40 dBA between 18:00 and 06:00, and 45 dBA between 06:00 and 18:00.

Section 13 refers to the noise evaluation methods prescribed in Schedules D and E.

Contact:

Mr. Jean-Pierre Létourneau
Noise Pollution Control Engineer
Direction de l'assainissement de l'air
Ministère de l'Environnement
2360, chemin Ste-Foy
Ste-Foy, Québec
G1V 4H2
(418) 643-5559

8.18 Alberta Oil and Gas Industry: Energy Resources Conservation Board (ERCB) Noise Control Directive (DD88-1)

Alberta has a greatly diversified population density from its unpopulated green areas through rural areas to suburban and high density urban developments. Because of increased non-renewable resource extraction, particularly in the rural areas, additional sources of noise are developing. Although concerns about energy-related noise do not tend to be a problem in urban centres, it is of concern in rural and suburban areas. People generally would prefer to see no increase in noise resulting from energy activity. Noise levels can be minimized by using noise control features in facility design, but usually it is not practical to completely eliminate any increase in noise level. Increased noise is considered acceptable if kept within certain limits, particularly where noise does not affect indoor noise levels or overall quality of life adversely.

The directive considers the existing background noise, industrial traffic, character of the noise, temporary or permanent sources, and seasonal sensitivity to noise to establish reasonable noise levels.

Contact:

Energy Resources Conservation Board
Environmental Protection Department
640 - 5th Avenue S.W.
Calgary, Alberta
T2P 3G4
Telephone (403) 297-3722

This directive is intended to apply where an application is made to the ERCB for new facilities or modifications to existing facilities. Existing facilities will be investigated only when complaints are received from residents.

When planning a facility, basic noise control features should be considered at the initial design stage rather than dealing with problems after start-up. The costs of retrofitting for noise reduction can be much higher than initially incorporating noise controls into the facility. Operators are encouraged to discuss noise matters with residents during the design, construction and operating phases of a facility.

This directive regards noise from a receptor standpoint rather than considering noise levels at the property line. Criteria based on property line measurements were considered too restrictive in rural settings.

The ERCB Guide has been prepared to understand this directive better. It outlines the step-by-step approach to deal with a noise problem, and also some of the background and rationale of the directive.

Available from:

Energy Resources Conservation Board
Environment Protection Department
640 Fifth Avenue S.W.
Calgary, Alberta
T2P 3G4

8.19 MOE: Ontario Hydro Protocol for Community Noise Program

This document is dated January 7, 1981. It sets out the desired philosophy and criteria that are applied by Ontario Hydro limiting audible noise from new facilities, from those that are upgraded and during construction of these facilities (in keeping with the objectives of the Provincial Environmental Protection Act 1971) to levels acceptable to the community.

Contact:

M. Osman, Ph.D.
Senior Design Specialist
Ontario Hydro
Power Equipment H13
700 University Avenue
Toronto, Ontario
M5G 1X6
Telephone (416) 592-4988

8.20 MOE Publication NPC-202 Instrumentation (Draft)

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law drafted by the Ministry for adoption by local municipalities in Ontario. Publication NPC-202 sets out minimal specifications for equipment used to measure sound and vibration. For most of the specifications, the International Electrotechnical Commission (IEC) recommended standards have been adopted.

This document serves as a guideline for all instrumentation to measure sound and vibration in the Province of Ontario, in connection with any evaluation, assessment, abatement or approval under the powers of the Environmental Protection Act, Environmental Assessment Act and Planning Act of Ontario.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.21 MOE Publication NPC-203 Procedures (Draft)

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law drafted by the Ministry for adoption by local municipalities in Ontario. Publication NPC-203 is composed of the various measurement procedures to be used in connection with other publications which provide limits or standards for sound or vibration. Several of the procedures adopted are those of the Canadian Standards Association (CSA) or other internationally recognized agencies. The procedures are provided as guidelines for any and all environmental noise measurements in the Province of Ontario.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.22 MOE Publication NPC-207 Impulse Vibration in Residential Buildings (Draft)

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law drafted by the Ministry for adoption by local municipalities in Ontario. Publication NPC-207 provides a method for the assessment and limitations for acceptability of impulse vibration measured inside an occupied residential building, caused by the operation of a stationary source of vibration outside the building.

The publication includes technical definitions specific to impulse vibration and its measurement, description of instrumentation, measurement procedures and applicable vibration limits.

The vibration limits identified by the publication are used as a guideline by the Ministry for assessment, abatement and approval purposes to evaluate the effect of impulse vibration on people in residential buildings.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.23 MOE Publication NPC-104 Sound Level Adjustments

This publication of the Ontario Ministry of the Environment is part of the Model Municipal Noise Control By-Law drafted by the Ministry for adoption by the local municipalities in Ontario. Publication NPC-104 refers to the adjustment of a sound level obtained following the procedures set out in either Section 3 or 4 of NPC-103, Procedures. The adjustments include adjustment for intermittence and special quality of sound such as tonality, cyclic variation or impulsiveness.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.24 Ontario Guidelines on Noise and New Residential Development Adjacent to Freeways

The Ontario Ministry of Housing, in consultation with the ministries of the Environment, and Transportation and Communication, announced a policy in 1979 to contain guidelines to control noise in outdoor areas of new residential developments near freeways. The policy described sets an objective of 55 decibels A-weighted as an outdoor noise level in residential developments. Where the outdoor noise level is likely to exceed the objective, the developer must demonstrate that measures will be taken to reach the objective level of 55 dBA as closely as possible.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.25 Ontario Initial Comments Procedure for Noise Impact on Proposed Residential Subdivisions

This six-page procedure issued in 1986 by the Ministry of the Environment provides a flowchart indicating a clear and simple procedure for the initial assessment of noise impact. Road, rail, aircraft and industrial sources of noise are considered. The initial comments normally are made by district and regional offices of the Ministry of the Environment and by planning departments of some regional municipalities.

Contact:

Leslie G. Kende, Supervisor
Noise Assessment and Systems Support Unit
Operational Services Approvals Branch
Ontario Ministry of the Environment
250 Davisville Avenue, 3rd Floor
Toronto, Ontario
M4S 1H2

8.26 Noise Control By-Law of the City of Winnipeg

This By-Law No. 2480/79, enacted December 6, 1979, prohibits defined noisy activities with certain exemptions.

Contact:

Clerk of the Municipality or
Adrian Jackson
Department of Environment and Workplace Safety and Health
Building 2
139 Tuxedo Boulevard
Winnipeg, Manitoba
R3N 0H6
Tel: (204) 945-7005

8.27 Noise Control By-Law of the Village of Lakefield

This By-Law No. 81-38, enacted June 26, 1981, designates areas of zoning for noise control purposes.

Contact:

Clerk of the Municipality
Box 400
#1 Bridge Street
Lakefield, Ontario
K0L 2H0
Telephone (705) 652-3381

8.28 Noise Control By-Law of the City of Toronto

This By-Law No. 44-75 passed February 20, 1975, has two parts. The first part prohibits certain noisy activities with certain limitations. The second part specifically prohibits noise emitted by certain devices under certain limitations. The by-law concludes with a list of exemptions to these provisions.

Contact:

Clerk of the Municipality
New City Hall
100 Queen Street West
Toronto, Ontario
M5A 2N1
Telephone (416) 329-8000

8.29 Noise Control By-Law of the City of Ottawa

By-Law No. 45-70 prohibiting the making of disturbing and objectionable noises was passed on March 6, 1985.

By-Law No. 268-56 respecting noises and public nuisances was passed on April 30, 1985.

By-Law No. 163-69 prohibiting noise in operation of motor vehicles on streets and public ways was passed on March 6, 1985.

By-Law No. 135-69 respecting engine whistling was passed on April 30, 1985.

Contact:

Clerk of the Municipality
111 Sussex Drive
Ottawa, Ontario
K1N 5A1
Telephone (613) 564-1414

8.30 Noise Control By-Law of the City of Calgary

This By-Law No. 9024, passed May 27, 1974, is to prohibit certain activities creating noise, abate the incidence of noise and restrict the hours when certain sounds can be made.

It is amended by By-Law numbers 135/75, 140/75, 130/77, 20M83, 58M86.

It is divided into sections entitled: General Prohibitions, Motor Vehicles Noises, Commercial and Industrial Noises, Domestic Noises, Construction Noises, Penalties and Repeal.

Contact:

Mr. C. Andrew
Transportation Department
City of Calgary
P.O. Box 2000
Station M
Calgary, Alberta
T2P 2M5

8.31 Noise Control By-Law of the City of Edmonton

This By-Law No. 7255, passed September 16, 1983, as amended, contains parts entitled: Title and Definitions, General Abatement Provisions, Vehicle Noise Abatement, Noise Level in Residential Districts, Noise in Commercial or Industrial Districts, Abutting Districts, Noise Readings.

Contact:

By-Law Enforcement Officer
City of Edmonton
Edmonton, Alberta

8.32 Quebec Publication

"COMBATTRE LE BRUIT DE LA CIRCULATION ROUTIÈRE:
Techniques d'aménagement et interventions municipales"

This document includes a brief explanation of what traffic noise is, how it propagates, and how it is evaluated and predicted.

It also describes various noise reduction techniques, and it thoroughly examines the administrative undertakings that can be considered in Quebec in order to control or prevent noise.

Contact:

Mr. Claude Girard
Ministère des Transports
Service de l'Environnement
255, boulevard Crémazie Est
9^{e} étage
Montréal (Québec)
Telephone: (514) 873-3440

Glossary of Terms and Interpretations

These definitions and interpretations of terms relate specifically to noise and noise control, and are intended to aid in understanding these National Guidelines. They may be incorporated into regulations or by-laws developed to control environmental noise. However, care must be taken not to redefine a term already defined in enabling legislation. If terms are already defined, it must be decided whether (i) the regulation or by-law can accommodate that definition, (ii) the term can be redefined in the enabling legislation, or (iii) another undefined term can be substituted and defined within the regulation or by-law. The latest edition of Canadian Standards Association Standard Z107.0 should be consulted for the most up-to-date use.

The words "criteria", "level", and "limits" are used somewhat interchangeably in some instances. For example, sound level objectives proposed by these National Guidelines are criteria or procedures adopted and published by a recognized standards-setting body such as the Canadian Standards Association. Care should be exercised when examining other documents, to which reference is made, that are quoted or presented in whole since these words will have specific meanings within their context.

Certain other words are difficult to define in clear, technical terms which could be interpreted consistently from case to case. The words "clearly audible" and "reasonable man" are examples. They probably should remain undefined to be open to the interpretation of the court, by-law enforcement officer, inspector or other person in each circumstance. Further comment and legal opinion are given in Section 3.2.

Terms such as "residential", "urban", "agricultural", "rural", and "quiet" zone and terms relating to highways or streets usually are defined already by the municipal or provincial agency authorized to enact noise legislation. Therefore, these terms are not exhaustively defined. Some helpful discussion is included where they are used in this document. It should be remembered that designation of land areas can be made and identified by the use of maps, legal and/or zoning descriptions.

Definitions and Interpretations

Absorption Coefficient

The (sound) "absorption coefficient" of a surface that is exposed to a sound field is the ratio of the sound energy absorbed by the surface to the sound energy incident upon the surface, and is a function of angle of incidence, frequency and impedance of the surface.

Acoustic Calibrator

An "acoustic calibrator" is an electro-mechanical or mechanical device that produces a sound of known frequency and sound pressure level for a calibration check of sound level meters or equivalent devices.

Acoustical Barrier

An "acoustical barrier" is a wall, berm, structure, fence or combination, designed to attenuate noise along the pathway from the source to the point of reception.

Acoustical Consultant

An "acoustical consultant" is a professional engineer or other competent individual with demonstrated experience in the field of noise and vibration control.

Agricultural Area

An "agricultural area" is an area designed for agriculture. In defining "agricultural area", care should be taken not to provide for inclusion of industrial or commercial operations.

Ambient Noise

"Ambient noise" is the all-encompassing noise associated with a given environment, and is usually a composite of sounds from many sources, other than the source of interest, near and far.

Ambient Sound Level

"Ambient sound level" is the sound level that is present in the environment produced by acoustical sources other than the source of interest.

A-Weighting

"A-weighting" is a frequency weighting intended to approximate the relative sensitivity of the normal human ear to different frequencies (pitches of sound). The specific variation of sensitivity with frequency shall conform to IEC Publication 651.

A-Weighted Sound Level

The "A-weighted sound level" is a sound pressure level indicated by a measurement system that includes an A-weighting network. The resulting value is in decibels and commonly is labelled dBA.

Beating

"Beating" is an audible, cyclically varying sound level, itself perhaps tonal, caused by the interaction of tones of slightly different frequency.

Buffer Zone

A "buffer zone" is a separation interposed between the noise source and the receiver. The zone may be any land use compatible with both the noise source and the receiver.

Buzzing Sounds

A "buzzing sound" is a sound characterized by the presence of a large number of related discrete harmonics in its frequency spectrum. These harmonics, together with the fundamental frequency, produce a sound which is termed (subjectively) a "buzz". Examples are sounds from a buzzer or a chain saw.

Construction

"Construction" includes erection, alteration, repair, dismantling, demolition, structural maintenance, painting, moving, land clearing, earth moving, grading, excavating, the laying of pipe and conduit whether above or below ground level, street and highway building, concreting, equipment installation and alteration, and the structural installation of construction components and materials in any form or for any purpose that includes any work in connection with the construction.

Construction Equipment

"Construction equipment" is any equipment or device designed and intended for use in construction or material handling, including but not limited to, air compressors, pile drivers, pneumatic or hydraulic tools, bulldozers, tractors, excavators, trenchers, cranes, derricks, loaders, scrapers, pavers, generators, off-highway haulers or trucks, ditchers, compactors and rollers, pumps, concrete mixers, graders or other material-handling equipment.

Conveyance

"Conveyance" includes a vehicle and any other device employed to transport a person or persons or goods from place to place but does not include any such device or vehicle if operated only within the premises of a person.

Council

"Council" is the registered corporate name of the municipality.

dB

See "Decibel".

dBA

See "A-Weighted Sound Pressure Level".

dBAI

See "Impulse Sound Level".

Decibel

The "Decibel" is the common measure of sound level or sound pressure. It is the term to identify 10 times the common logarithm of the ratio of two like quantities proportional to power or energy. Thus, one decibel corresponds approximately to a power ratio of 1.259, and n decibels corresponds approximately to a power ratio of $(1.259)^n$. (See also definitions of sound pressure level.)

NOTE: Since the decibel expresses a ratio of two like quantities, it is dimensionless. It is, however, common practice to treat decibels as units, as in the sentence, "The average sound pressure level in the room is 45 dB".

Environmental Noise

"Environmental noise" is noise transmitted through the outdoor environment as opposed to noise generated and contained within buildings.

Equivalent Sound Pressure Level

"Equivalent sound pressure level" (L_{eq}) is the level of a steady sound having the same time integral of the squared sound pressure, in the measurement interval, as the observed sound.

$$L_{eq,T} = 10 \log \left[\frac{1}{T} \int_{t_1}^{t_2} \left(\frac{p(t)}{P_o} \right)^2 dt \right]$$

where
$p(t)$ is the instantaneous sound pressure
P_o is the reference sound pressure (20 μPa)
$T = t_2 - t_1$ is the time interval

The determination of L_{eq} is done most commonly by periodically sampling the level during the time interval, and combining these samples numerically (for example, by digital processing equipment) using the equation:

$$L_{eq,T} = 10 \log \left(\frac{1}{n} \sum_{i=1}^{n} 10^{L_i/10} \right)$$

where

L_i are the levels observed at n equally spaced times during the interval T. When not otherwise qualified, L_{eq} is taken to mean equivalent A-weighted sound level, sometimes denoted by L_{Aeq}.

Fast Response

"Fast response" is a specific dynamic response characteristic of a sound level meter or other indicating device that conforms to ANSI Standard S1.4 or IEC Publication 651.

Flat Weighting

"Flat weighting" is a uniform sensitivity over a specific frequency range.

NOTE: The acoustical or electrical conditions and frequency range within which the sensitivity of an instrument is uniform within a given tolerance normally will be

found in the information provided by the manufacturer.

Frequency

The "frequency" is the number of complete oscillations (or cycles) per second of a periodically varying quantity (e.g. pressure, displacement, voltage). The unit is the hertz (Hz).

General Purpose Sound Level Meter

A "general purpose sound level meter" is a sound level meter that is intended to measure steady sound, excluding quasi-steady impulse and buzzing sounds, without significant A-weighted acoustic energy above 20 000 Hz, and which meets Type 2 Specification in IEC Publication 651, Sound Level Meters.

Hours of Darkness

"Hours of darkness" may be defined by the appropriate authority for purposes of limiting the occurrence of certain activity.

Impulse Response

"Impulse response" is a specific dynamic response characteristic of a sound level meter or other indicating device that conforms to IEC Publication 651, Sound Level Meters.

Impulse Sound

"Impulse sound" is a discrete pressure pulse or a series of such pressure pulses having a combined duration of between 1 ms and 1 s and a repetition rate up to about 2 Hz.

Impulse Sound Level

"Impulse sound level" is the A-weighted sound level measured with an impulse sound level meter set to measure impulse response. It is measured in decibels, denoted dBAI.

Impulse Sound Level Meter

An "impulse sound level meter" is a sound level meter to measure impulse and steady sound, including quasi-steady impulse and buzzing sounds. It must conform to Type 1(I) Specification in IEC Publication 651, Sound Level Meters, and include an impulse response setting.

Integrating Sound Level Meter

An "integrating sound level meter" is a sound level meter that is used to measure sound over a period of time such that the equivalent sound level (Leq) of the source may be derived, in conformance with IEC Publication 804, Integrating-Averaging Sound Level Meters.

Leq

See "Equivalent Sound Pressure Level".

Logarithmic Mean Impulse Sound Level

The "logarithmic mean impulse sound level", sometimes denoted LLM, of N impulsive sounds, is 10 times the logarithm to the base 10 of the arithmetic mean of 10 to the power of one tenth the impulse sound level of each impulse sound.

Algebraically, it can be written as:

$$L_{LM} = 10 \log 10^{\frac{1}{N}} (10^{dBAI_1/10} + 10^{dBAI_2/10} \ldots + 10^{dBAI_N/10})$$

where, $dBAI_1$, $dBAI_2$, ... $dBAI_N$, are the N impulse sound levels.

Loudness

"Loudness" is the intensive attribute of an auditory sensation, in terms of which sounds may be rated on a scale extending from soft to loud. Loudness depends primarily on the sound pressure of the stimulus but it also depends on the frequency and wave form of the stimulus.

Microphone

A "microphone" is a transducer that converts an acoustic disturbance into an electrical output signal that is proportional to the acoustic disturbance, and should conform to specifications in IEC Publication 651, Sound Level Notes.

Minister

"Minister" is the cabinet minister responsible for the department which provides enabling legislation.

Ministry

"Ministry" is the provincial department which provides enabling legislation.

Motor Vehicle

"Motor vehicle" is any vehicle designed to be driven and drawn on roads by means other than exclusively by muscular power, and includes pedal cycles with auxiliary motors, minibikes, motorized snow vehicles but does not include any vehicle designed for running exclusively on rails.

Motorized Conveyance

"Motorized conveyance" is a conveyance propelled or driven other than by muscular, gravitational or wind power.

Municipality

"Municipality" is the land within the geographic limit of a particular municipality.

Noise

"Noise" is unwanted sound.

Noise Control Officer

"Noise control officer" is a person designated as responsible for the administration of a noise control by-law.

Outdoor Recreational Area

"Outdoor recreational area" refers to an outdoor amenity area where the enjoyment of the outdoor environment is important. These amenity areas include, but are not limited to, the following:

(i) yards including front yards, backyards, gardens, terraces or patios of dwellings;

(ii) common outdoor areas allocated for recreational purposes such as areas outside apartment buildings, condominiums, group homes, hospitals and schools;

(iii) parks and open spaces allocated for recreational purposes within a subdivision plan.

Overpressure

See "Peak Pressure".

Peak Particle Velocity

The "peak particle velocity" is the maximum instantaneous velocity experienced by the particles of a medium in vibratory motion.

NOTE: Velocity is a vector quantity, and is described frequently in terms of three orthogonal components.

Peak Pressure

"Peak pressure" is the maximum instantaneous sound pressure during an acoustic disturbance. The common unit of measurement is the pascal. One pascal (Pa) is one newton per square metre (N/M^2).

Peak Pressure Level

"Peak pressure level" is the maximum instantaneous sound pressure level during an acoustic disturbance.

Peak Pressure Level Detector

A "peak pressure level detector" is a device capable of indicating the peak pressure occurring during an acoustic disturbance, and expressing this quantity in decibels as a sound pressure level conforming to IEC Publication 651.

Peak Vibration Velocity

The "peak vibration velocity" is the maximum zero to peak (positive or negative) velocity, experienced by the particles of a medium in vibratory motion. The common unit is metres per second.

Percentile Sound Level

The "x percentile sound level", designated L_x, is the sound level exceeded x percent of a specified time period. When not otherwise specified, L_x means the A-weighted sound level.

Pitch

"Pitch" is the auditory sensation that correlates with frequency.

Point of Reception

The "point of reception" is any point on the premises of a person where sound or vibration, originating from other premises, is received.

Publication

"Publication" is a specified publication attached to, and thereby made part of a noise control by-law.

Precision Sound Level Meter

"Precision sound level meter" is a sound level meter that is intended to measure steady sound, including quasi-steady impulse and buzzing sounds, and which conforms to Type 1 Specification in Publication IEC 651, Sound Level Meters.

Property Line

A "property line" is an imaginary line along the ground surface and its vertical extension, which separates the real property owned by one person from that owned by another person, but not including intra-building real property divisions.

Pure Tone

"Pure tone" is a sound consisting of a single frequency and having, therefore, a sinusoidal fluctuation in sound pressure.

Qualitative

"Qualitative" describes a type of noise legislation that does not require setting sound level limits or measurement of sound levels to determine compliance. Such legislation simply may prohibit certain operations by time and place. Specific information and examples are contained in Section 4.

Quantitative

"Quantitative" describes a type of legislation that may include the qualitative type of clause but also includes sound level limits relating to sources and receptors, and specified procedures for their measurement and determination of compliance. Specific information and examples are contained in Section 4.

Quasi-Steady Impulsive Sound

"Quasi-steady impulsive sound" is a sequence of impulsive sounds emitted from the same source, having a time interval of less than 0.5 seconds between successive impulsive sounds.

Quiet Zone

A "quiet zone" is a geographical area that may encompass hospitals, schools, special care homes and other institutions, requiring special consideration in noise control by-laws.

Roadway

"Roadway" includes a common and public highway, street, avenue, freeway, arterial road, parkway, driveway, square, place, bridge, viaduct or trestle designed and intended for, or used by, the general public for passage of vehicles.

Slow Response

"Slow response" is a specific detector-indicator response characteristic of a sound level meter or other device that conforms to IEC Publication 651, Sound Level Meters.

Sound

"Sound" is:

(i) a fluctation in pressure, particle displacement or particle velocity propagated in any medium; or,

(ii) the auditory sensation that may be produced by (i).

Sound Intensity

The "sound intensity", measured in a specified direction at a point, is the average rate at which sound energy is transmitted through a unit area to which the specified direction is perpendicular (see "Sound Power").

Sound Level

"Sound level" is a sound pressure level indicated by a measurement system (e.g., sound level meter) with dynamic response and weighting characteristics conforming to the requirements of ANSI Standard S1.4 or IEC Standard 651.

Sound Level Meter

A "sound level meter" is an instrument to measure sound pressure level over the audible frequency range with a specified frequency weighting and dynamic response characteristic.

NOTE: Measurement may be made using linear or flat response, one of the designated weighting networks (A,C, etc.), or octave or fractional-octave filtering. Instruments are classified according to dynamic characteristics, accuracy and versatility. For example, there are precision instruments (see ANSI Standard S1.4, Type 1, and IEC Publication 651), general purpose instruments (see ANSI Standard S1.4, Type and IEC Publication 651), survey and special purpose instruments (see ANSI Standard S1.4, Type 3 and S1). See also "Impulse Sound Level Meter" and "Integrating Sound Level Meter".

Sound Power (W)

"Sound power" is the rate of flow of acoustic energy in a specified frequency range, whether from a source, through an area or into an absorber.

Sound Power Level (L_w)

"Sound power level" is for airborne sound, 10 times the common logarithm of the ratio of the sound power under consideration to the standard reference power of 1 pW. The quantity obtained is expressed in decibels. When not otherwise qualified, the term denotes flat-weighted sound power level.

Sound Pressure

The "sound pressure" is the difference between instantaneous pressure at a point in a medium during the passage of an acoustic disturbance and the prevailing pressure at the same point in the absence of that disturbance. (The medium of interest is generally the atmosphere.)

Sound Pressure Level (L_p)

"Sound pressure" is 10 times the common logarithm of the ratio of the mean square pressure of a sound to the square of the reference pressure of 20 micropascals. Thus, the sound pressure level in decibels is:

$$L_p = 10 \log \left(\frac{\bar{p}}{p_o} \right)^2$$

where

$\bar{p}$ is the root mean square sound pressure

p_o is the reference pressure of 20 μ Pa

NOTE: In practice, such measurements involve some form of integration (linear or exponential) over a specified time interval.

Standard

A "standard" is a set of criteria such as maximum ambient sound levels, emission levels, methods of measurement or procedures which have been adopted and published by a recognized standard-setting body.

Stationary Source

"Stationary source" is a source of sound that does not move normally from place to place, and includes the premises of a person as one stationary source, unless the dominant source of sound on those premises is construction or a conveyance. For example, an authority may regard a piece of mobile equipment such as a loader as part of a stationary source when it operates within a premise, whereas, if the same piece of equipment moves to the public domain such as working on a street, it could be regarded as a mobile source.

Steady Sound

"Steady sound" is a sound whose A-weighted sound level measured on slow response varies by 3 dB or less about a mean value.

Tone

A "tone" or a "tonal sound" is a sound dominated by one or more pure tones.

Varying Sound

A "varying sound" is a sound whose A-weighted sound level measured on slow response varies by 3 dB or more about a mean value.

Vibration

"Vibration" is a perturbation in displacement, velocity or acceleration in a solid medium.

Vibration Amplitude

"Vibration amplitude" is the magnitude of oscillatory displacement, velocity or acceleration of a particle of the medium. The unqualified term denotes the zero-to-peak value.

NOTE: Modified forms are the peak-to-peak amplitude and the root-mean-square (rms) amplitude.

Vibration Detector

"Vibration detector" is a device intended to indicate the displacement, velocity or acceleration of a vibrating medium. (The medium of interest is generally a solid.)

Vibration Velocity Detector

See "Vibration Detector".

White Noise

"White noise" is noise of a statistically random nature having equal energy per unit frequency over a specified total frequency band.

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(of Federal/Provincial Advisory Committee
on Environmental and Occupational Health)

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